GAS IMPORT JETTY AND PIPELINE PROJECT
ENVIRONMENT EFFECTS STATEMENT
INQUIRY AND ADVISORY COMMITTEE

TECHNICAL NOTE

TECHNICAL NOTE NUMBER:	TN 013
DATE:	07 October 2020
LOCATION:	Crib Point Jetty and Pipeline Works
EES/MAP BOOK REFERENCE:	N/A
SUBJECT:	Proponents response to request for further information received from Mornington Peninsula Shire Council (**MPSC**)
SUMMARY	The documents attached to this technical note were provided to MPSC in response to their two requests for further information on 14 and 16 September 2020.
REQUEST:	MPSC requested further information from the proponents about the EES and potential impacts on shorebirds and waterbirds.

NOTE:

MPSC Request for further information

1. On 14 and 16 September 2020, the Proponents received a request for further information from MPSC. These requests are tabled as document number 46 and 47 respectively.
2. On 28 September 2020, the Proponents responded to the MPSC request.

Documents

3. The following documents make up the Proponents response to the MPSC request:
    (a) Letter dated 28 September 2020 sent from Ashurst and Hall & Wilcox on behalf of the Proponents to Harwood Andrews regarding responses to the MPSC RFIs received on 14 and 16 September.
    (b) Proponents responses to MPSC RFIs received on 14 and 16 September 2020.
    (c) The spreadsheet used to generate the Crib Point Import Jetty's greenhouse gas emission calculations in Appendix B and C of Technical Report F for the purposes of responding to MPSC RFI 1 under the section "EES Chapter 11: Greenhouse gas and Technical Report F (Greenhouse gas impact assessment)" of the 14 September request.
    (d) The spreadsheet used to generate the Crib Point-Pakenham Pipeline's greenhouse gas emission calculations in Appendix B and C of Technical Report F for the purposes of responding to MPSC RFI 1 under the section "EES Chapter 11: Greenhouse gas and Technical Report F (Greenhouse gas impact assessment)" of the 14 September request.
    (e) The spreadsheet used to generate a simple calculation of Scope 3 upstream emissions for the purposes of responding to MPSC RFI 3 under the section "EES Chapter 11: Greenhouse gas and Technical Report F (Greenhouse gas impact assessment)" of the 14 September request.

CORRESPONDENCE:

1. Letter dated 14 September 2020 received from Harwood Andrews on behalf of MSPC requesting further information in relation to the project. (Tabled as doc #46)

2. Letter dated 16 September 2020 received from Harwood Andrews on behalf of MSPC requesting further information in relation to the project. (Tabled as doc #47)

3. Letter dated 28 September 2020 sent from Ashurst and Hall & Wilcox on behalf of the proponents to Harwood Andrews with responses to the MPSC RFIs received on 14 and 16 September.

ATTACHMENTS: 5 Attachments.

1. Letter dated 28 September 2020 sent from Ashurst and Hall & Wilcox on behalf of the Proponents to Harwood Andrews.

2. Proponents response table to MSPC RFIs.

3. Spreadsheet of GHG emissions calculations for the Crib Point Import Jetty re. MPSC RFI 1 under the section "EES Chapter 11: Greenhouse gas and Technical Report F (Greenhouse gas impact assessment)".

4. Spreadsheet of GHG emissions calculations for the Crib Point-Pakenham Pipeline re. MPSC RFI 1 under the section "EES Chapter 11: Greenhouse gas and Technical Report F (Greenhouse gas impact assessment)".

5. Spreadsheet calculating Scope 3 upstream emissions re. MPSC RFI 3 under the section "EES Chapter 11: Greenhouse gas and Technical Report F (Greenhouse gas impact assessment)".

Attachment 1

Ashurst Australia
Level 26
181 William Street
Melbourne VIC 3000
Australia

Tel +61 3 9679 3000
Fax +61 3 9679 3111
DX 388 Melbourne
www.ashurst.com

28 September 2020

BY EMAIL: kmorris@ha.legal

Kate Morris
Harwood Andrews
Level 5, 707 Collins Street
Melbourne VIC 3008

Hall & Wilcox
Level 11
Rialto South Tower, 525 Collins St,
Melbourne VIC 3000
(03) 9603 3555

Dear Kate

Crib Point Inquiry and Advisory Committee

We confirm that we act for the Project proponents, AGL and APA, respectively.

We refer to your letters on behalf of Mornington Peninsula Shire Council dated 14 and 16 September 2020 regarding requests for further information about the EES and potential impacts on shorebirds and waterbirds.

We **attach** two tables of response to each of these request letters. These tables provide brief responses to each of the questions contained within the request letters.

For the assistance of the IAC documentation process these two tables will separately be attached to a Technical Note for filing as a document within the proceeding.

We note that a number of matters raised here are similar to questions raised by the IAC and which will be the subject of direct responses in the evidence, submissions or Technical Notes.

Our response tables will also be provided to expert witnesses in relevant topics for their review and comment.

If you have any questions, please contact Sophie Osborn on (03) 9679 3881 or Meg Lee on (03) 9603 3312.

Yours faithfully

Ashurst **Hall & Wilcox**

Attachment 2

Requests received from Harwood Andrews on 14 September 2020

No.	Request	Response to request
EES Chapter 6: Marine biodiversity and Technical Report A (Marine biodiversity)		
1	Clarification as to whether any regasification would occur whilst an LNG carrier was berthed adjacent to the FSRU at Crib Point.	Note a Technical Note is being prepared to respond to related questions in the IAC's RFI request. Sections of Technical Report A that assess this scenario are presented in Sections 6.4.9, 6.4.10, 6.4.15, 6.5.9 and 7.8.11. The operation of the FSRU will be in accordance with an OEMP to be approved as part of the Environmental Management Plan and in consultation with the EPA. The EES shows that the area of impact is minimised when an adjacent vessel is not present or the FSRU is not operational during these times. AGL is proceeding on the basis that its operations will be consistent with a performance based minimised mixing zone. The EES shows a default position whereby the area of impact is minimised when the FSRU is not operated with an adjacent vessel. This would be one way to achieve performance however the OEMP would provide flexibility to support operation or design innovation to achieve a similar performance.
2	Clarification as to whether any regasification occur whilst an oil carrier was berthed at Berth 1, Crib Point.	At times regasification may occur whilst a United Petroleum carrier is berthed at Berth 1, Crib Point. The cumulative impact assessment in Section 8.5.3 of the CEE marine ecology assessment (Technical Report A) considers this scenario qualitatively.
3	Clarification as to the balance in ballasting between the FSRU and LNG carrier in terms of volume and timing (i.e., discharge of ballast from the FSRU and uptake of ballast by the LNG carrier) whilst transferring LNG between the carrier and the FSRU.	When loading LNG from an LNG carrier, the FSRU begins the de-ballasting process when the LNG transfer operation is initiated and full loading rate is achieved. The de-ballasting then goes on through the LNG loading process. In accordance with the procedures, the de-ballasting should be completed (minimum) one hour before the LNG transfer is completed. When starting the de-ballasting operation, the ballast tanks are typically emptied by gravity. Once the ballast discharging rate slows down, the ballast pumps are started to complete the de-ballasting. The volume of ballast water (and time) will be dependent on whether a full or a partial cargo would be loaded. It is expected that the LNG carrier will follow the same operational approach when offloading LNG to the FSRU, however it will be the other way around with ballast water being taken in to

No.	Request	Response to request
		compensate for the discharged LNG, the ballasting process being completed 1 hour before the LNG offloading is complete.
4	Clarification as to the duration of passage of seawater through the heat exchanger from uptake to discharge.	See Section 6.5.1 of the Technical Report A - Marine Biodiversity.
5	Clarification as to the minimum temperature of seawater within the heat exchanger and the temperature at the point of discharge from the 6 ports.	In accordance with the design parameters of the regas system, the sea water temperature differential between the sea water inlet to the regas module, and the sea water outlet from the regas module is (max) 7degC. The sea water temperature at the 6 discharge ports will then be (max) 7degC colder than at the ambient seawater temperature in open loop mode. In practical terms, as previously mentioned the temperature differential in operation is expected to be slightly less than 7degC in open loop mode, as some design margin is applied and there is also the reuse of heated cooling water from the engine room cooling water consumers.
6	Modelling of tug wash, including suspension of fine sediment and its potential for turbid water to impinge on seagrasses adjacent to the jetty – for tug operations associated with the arrival and departure of vessels to and from the Crib Point jetty.	Tug wash was not modelled for EES assessment purposes. However, submissions raising tug wash were referred to Dr Ian Wallis for consideration in evidence. Technical Report A (Marine biodiversity) and the MNES report consider potential ship wash impacts in a qualitative manner.
7	Further information on existing contaminants in sediments of Berth 1 basin noting the EES identifies the presence of TBT. This should include analysis of sediments for PAHs, metals, grain size and total carbon content.	Information regarding sediments is presented in Technical Report E – Appendix A (Field Investigations) and analytical results in Table B13 of Appendix B (of the Field Investigation report). Table B13 includes data for both Berth 1 and Berth 2. Analysis of sediment samples was undertaken for PAH's, metals, TOC and a range of other analytes. The concentrations of analytes were below the adopted investigation level, with the exception of arsenic and TBT which are situated outside the project area as noted.
8	Analysis of sediment samples in and surrounding the Berth 1 basin (within any areas likely to be disturbed by discharge of water from the FSRU or associated with turbulence from tugs, the LNG carrier, etc.) for presence of toxic dinoflagellates.	Section 7-10-2 of Technical Report A states that *Marine sediments near Berth 1 are contaminated in places, but not at Berth 2. The seabed scour processes near Berth 2 related to the FSRU and LNG carrier operation would not disturb or transport the contaminated sediments that occur near Berth 1.*
9	Quantitative survey of fish and benthic invertebrates in the Berth 1 basin, with replicated sampling at 4 to 5 sites within	Fish in Western Port described in Section 59 of Technical Report A and in more detailed annexure.

No.	Request	Response to request
	the Berth 2 basin and within 4 to 5 sites within at least two control locations.	Benthic invertebrates were sampled at 29 sites in Lower North Arm (including sites at Berth 2, Berth 1 and inshore of the jetty at Crib Point) and elsewhere in the main channel including sites sampled in the Westernport Bay Environmental Study. Results are presented in Section 5.4.3 of Technical Report A, and in a more detailed technical annexure. See also the expert witness statement of Mr Chidgey, response to submissions (MPSC), from p 29.
10	Quantitative survey of epifauna and associated fishes and mobile invertebrates (with emphasis on Syngnathidae and fish that may be entrained in the intake of the FSRU) within Crib Point jetty environment and comparison of this information with two other jetty structures in Western Port.	The main Crib Point jetty structure is 65 m to the west of the FSRU. The seawater intakes are towards the rear of the FSRU (Refer to 4.4 of the Project Description). Table 6-7 (*Dimensions of entrainment zone from the FSRU sea chest*) shows that the entrainment zone is a maximum width of 21.7 m at slack water and about 2 m at peak tidal currents – so the entrainment zone is well offshore from the main jetty. Therefore, it is not expected that fish living under the jetty would be entrained. See also the expert witness statement of Mr Chidgey, response to submissions (MPSC), from p 29.
11	Surveys of diving birds (e.g. species of cormorants and gulls) at Crib Point jetty, including species identifications, abundance, roosting and feeding behaviour, and an assessment of likely diet of these species.	No specific surveys for diving birds were undertaken, but they were recorded wherever observed, including during the wader and waterbird surveys, and listed in Table A2.1. Any threatened diving birds are listed in Table A2.2.
12	Updated and detailed monitoring proposal including detailed monitoring plan.	See MM-ME16 in Chapter 25 *Environmental Management Framework*. The marine monitoring program will be prepared in consultation with the EPA and will be included in the Gas Import Jetty Works OEMP. See also the expert witness statement of Mr Chidgey, response to submissions (EPA), p 17.
13	A survey of biota associated with reef/jetty habitat (e.g. algae, invertebrates, fish) and impact assessment on the same.	As explained in Section 5-6 of Technical Report A, there is no reef within several kilometres of Crib Point jetty. As explained in Question 10, Table 6-7 (*Dimensions of entrainment zone from the FSRU sea chest*) shows that the entrainment zone is a maximum width of 21.7 m at slack water and about 2 m at peak tidal currents – so the entrainment zone is well offshore from the main jetty. Therefore, it is not expected that fish living under the jetty would be entrained.
14	A survey of the intertidal and subtidal mudflat communities (includes seagrasses & associated biota) adjacent to Crib Point and impact assessment on the same.	Benthic invertebrates were sampled at 29 sites in Lower North Arm (including sites at Berth 2, Berth 1 and inshore of the jetty at Crib Point) and elsewhere in the main channel including sites sampled in the Westernport Bay Environmental Study. Results are

No.	Request	Response to request
		presented in Section 5.6 of Technical Report A, and in a more detailed technical annexure. The temperature impact envelope (see Figure 7-18) and chlorine impact envelope (see Figure 7-29) do not extend to the intertidal and mudflat communities. Thus, studies were focused on the areas where impacts could occur, not on areas where they are unlikely to occur.
15	An assessment of plankton in relation to study area.	Technical Report A contains the most comprehensive investigation of plankton ever undertaken in Western Port. Section 5-8 described the plankton communities in 50 pages. Section 6-6 described the impact of entrainment on plankton communities. There is an assessment of serval identified risks relating to plankton.
16	A survey of local fish species proximate to Crib Point and impact assessment on the same, with impacts on demersal and pelagic fish should be considered separately.	Fish in Western Port are described in Section 5-9 and in the more detailed annexure. The seawater intake has been designed in accordance with US EPA principles to minimise the risk of capture of adult fish in the intake. Thus, studies were focused on larval fish that would be impacted, not on adult fish where the impacts would be minor and less than recreational fishing.
17	An assessment of the impact of warm water from the discharge plume on fish associated with the jetty structure.	The temperature impact envelope (see Figure 7-18) does not extend to the Crib Point jetty. Thus, studies were focused on the areas where impacts could occur, not on areas where they are unlikely to occur.
18	An assessment of the impact of fish being exposed to the chlorine plume.	The impact of temperature on pelagic and demersal fish is assessed in Section 7-7-13. The impact of chlorine on pelagic and demersal fish is assessed in Section 7-8-19.
19	An assessment of impacts associated with potential intermittent pulse disturbances during periods of regasification and plume discharge.	It is not clear what these periods of “intermittent pulse disturbances” are. The marine risk assessment is based on an upper limit of 750 MMscfd of gas production in the peak month and an average of 500 MMscfd over the year, with an indicative annual variation in production as set out in Figure 10-1 of Technical Report A.
20	A survey and assessment of the underwater noise environment of Western Port (soundscape), including an impact assessment on birds and invertebrates;	There was no survey as such. The underwater noise assessment has been peer reviewed and has been explained in Mr Marks evidence.
21	An assessment of the combined effect of chlorine, reduced water temperature and electrolysis on entrained biota.	As stated in Section 7-6-3, it is assumed that none of these biota would survive as a result of mechanical damage and exposure to chlorine produced oxidants produced by electrolysis of seawater at the intake,

No.	Request	Response to request
		although this is a conservative assumption for the reasons set out in Technical Report A. .
EES Chapter 9: Groundwater and Technical Report D (Groundwater Impact Assessment)		
See also the expert witness statement of Mr Medd, response to submissions, section 6.3, from p 20.		
1	A baseline dataset based on seasonal groundwater level data, including of the basalt aquifer.	Seasonal groundwater level data were not collected as part of the site investigations. However, as outlined in Section 5.9 of *EES Technical Report D: Groundwater Impact Assessment,* to mitigate the absence of temporal groundwater level data the impact assessment conservatively assumed high groundwater level scenarios when considering potential impacts to groundwater and groundwater users (including potential GDEs).
2	A sensitivity analysis of the mounding and dewatering impacts.	A sensitivity analysis for dewatering estimates was not considered warranted. As outlined in Section 7.1.1. of *EES Technical Report D: Groundwater Impact Assessment*, the dewatering scenarios are a worst case assessment to provide 'the estimated maximum drawdown that may occur because of construction dewatering if shallow groundwater was encountered during construction." Mounding of groundwater is not considered a likely potential effect from the Project.
3	Details of investigation and analysis of groundwater quality between boreholes KP7.3 and KP7.9.	Details of the groundwater investigation are presented in EES Technical Report E – Appendix A. Groundwater monitoring well CPT022_MW05 was installed at KP7.3 and groundwater monitoring well CT027_MW06 was installed at KP8.7. Groundwater gauging details are presented in Table B4 (Appendix B). The water table in MW06 was 4.064m below ground surface and was therefore not sampled. MW05 was sampled and the groundwater quality results are presented in Table B12 (Appendix B). As set out in Section 5.1.2 of Technical Report E, the area between boreholes KP7.3 and KP7.9 has been identified as potentially contaminated based on adjacent land use (metal recycling yard and industrial sites), but dense vegetation restricted access for testing. MM-C01 and MM-C04 require intrusive soil and groundwater investigations respectively between KP7.3 and KP7.9, once vegetation has been cleared, to confirm the presence or absence of contaminated soils, with additional mitigation measures required if contamination is identified.

No.	Request	Response to request
4	Clarification regarding the following in the dewatering and drawdown estimates in Attachment H of Technical Report D:	
	(a) On the right-hand side of spreadsheet 1 states the flow rate per bore is 0.6 L/sec however in the table on the left-hand side it states 0.0069 L/sec.	RHS of spreadsheet should read 0.6 cubic metres per day (not L/sec) and corresponds to the 0.6 cu.m. per day in left of spreadsheet. This equates to the 0.0069 L/sec.
	(b) In table on the left-hand side of spreadsheet 1, the total volume produced during the test is 1.2 kL, however based on the pumping rate of each well (i.e. 0.6 m3/day) the total volume produced should be 20 m3/day.	The 1.2 kL produced over the test is for one bore (at 0.6 cu.m per day for two days). The total produced from all bores equates to 20 cu.m per day (0.6 cu.m per day for 33.3 bores over 100 m trench length).
	(c) Spreadsheet 2 (thrust bore bell hole or HDD tie-in bell hole) predicts the drawdown at 25m (i.e. 0.10m) whereas Table 7-1 of the report states the drawdown is at 0.78m.	Spreadsheet 2 is in error. Table 7-1 is correct.
5	Recovery modelling associated with the GDEs.	See the expert witness statement of Mr Medd, response to submissions, section 6.3.1.2, p 22-23.
EES Chapter 11: Greenhouse gas and Technical Report F (Greenhouse gas impact assessment)		
1	The spreadsheets used to generate the greenhouse gas emission estimates/calculations in Appendix B and C of Technical Report F.	These spreadsheets are provided by email together with this response.
2	Detailed rationale behind assumptions used in calculations including reason for selecting Qatar as the source of LNG.	LNG could be sourced from a variety of locations around the world, and Qatar was considered as a conservative source location due to the distance between Qatar and Crib Point (and therefore the derivation of a larger transport distance than if the LNG was sourced from a location that is closer).
3	An inventory of Scope 3 upstream emissions. This should include the data used for extraction and liquefaction of LNG.	This was not in the scope of the assessment therefore the proponents did not compile an inventory for this. The proponents estimated the associated GHG based on the annual volume of gas imported. See attached spreadsheet which provides the simple calculation that was done. The reference for the emissions factor in the report and the attached is the Qatargas 2018 Sustainability Report NOTE – The evidence includes a review of greenhouse gas emissions by Mr Sichlau.

No.	Request	Response to request
EES Chapter 13: Noise and Vibration and Technical Report H (Noise and Vibration Impact Assessment)		
1	The computer noise model used in calculations in Technical Report H.	23 September 2020 – the proponents have provided Harwood Andrews with the information required inviting Mr Antonopoulos (SLR Consulting) to contact AECOM directly regarding the noise model.
EES Chapter 15: Transport and Technical Report J (Transport)		
1	Analysis of the following additional intersections (with high number of accidents):	See the expert witness statement of Ms Dunstan. Ms Dunstan considers the need for analysis of additional intersections and makes the following recommendation: *The RSA should be expanded to include a review of the Frankston-Flinders Road/Denham Road roundabout as this intersection will be used for a longer period of time for construction purposes (due to the Denham Road stockpile and project offices) and has a history of casualty crashes (4 over 5 years).*
	(a) Frankston-Flinders Road / Bungower Road	
	(b) Frankston-Flinders Road / Eramosa Road	
	(c) Coolart Road / Myers Road	
	(d) Coolart Road / Bungower Road	
	(e) Dandenong-Hastings Road / Bungower Road	
	(f) Frankston-Flinders Road / Denham Road	
2	Swept path analysis to confirm whether larger trucks required can enter and exit access tracks satisfactorily.	The TMP and Road Safety Audit required by recommended mitigation measures will address this request. **Traffic Management Plan (TMP)** A Traffic Management Plan (TMP) will be prepared and implemented for construction by an appointed contractor for approval by the relevant local government authorities and VicRoads. The TMP will include specific measures for discrete components or stages of the works having the potential to impact on roads, shared use paths, bicycle paths, footpaths or public transport infrastructure. The TMP will include a number of sub-plans including:

No.	Request	Response to request
		• Public Transport Disruption Management sub-plan • Pedestrian and cyclist connectivity **Road Safety Audit** Intersections will be designed and constructed to provide safe vehicle movements to the satisfaction of the responsible road management authority. A Road Safety Audit will be undertaken upon finalisation of the proposed routes and access tracks to confirm mitigation measures. This will consider investigating existing warning signage, lighting, turning movement lane provision and sight clearance and access track alignment modifications to improve safe intersection sight distance (SISD) for those that are non-conforming. This includes management measures such as advanced warning signage and flag lighting. See also the expert witness statement of Ms Dunstan.
3	Further detail regarding how access track intersections with sight distances shortfalls will be managed.	The TMP and Road Safety Audit required by recommended mitigation measures will address this request. See above at 2. See also the expert witness statement of Ms Dunstan.
4	An assessment of the potential impacts of car parking at construction sites/access tracks.	The TMP and Road Safety Audit required by recommended mitigation measures will address this request. See above at 2.

Requests received from Harwood Andrews on 16 September 2020

No.	Request	Response to request
EES Chapter 6: Marine biodiversity, Chapter 7: Terrestrial and freshwater biodiversity, Technical Report A (Marine biodiversity) and Technical Report B (Terrestrial and freshwater biodiversity		
1	**The following further information regarding the shorebird surveys conducted for the EES:**	
a	The GPS coordinates of each sampling site and the position(s) of survey personnel.	The method used to determine the existing conditions within the Project study area and to assess impacts and risks to terrestrial and freshwater biodiversity associated with the Project is provided in Section 4 of EES Technical Report B. As noted in Section 4.1.4.2 of EES Technical Report B, as a Ramsar site, Western Port is an internationally recognised area of important habitat for migratory shorebirds. This is supported by numerous studies and survey records over many years (Loyn et al. 2001, Dann et al. 2003, Kellogg Brown & Root 2010, Hansen et al. 2011, Menkhorst et al. 2014, Hale 2016, Melbourne Water 2018). As the importance of shorebird habitat within Western Port has already been recognised, and there is suitable, credible data available, further surveys were not necessary to establish its importance. This is consistent with EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (Commonwealth of Australia 2017). Targeted surveys were undertaken to ascertain the types of habitat present in close proximity to the Gas Import Jetty Works study, assess their suitability for shorebirds and to document waterbird presence there. The surveys were undertaken to provide additional information to the large number of existing records of waders and waterbirds from Western Port, with the intention of providing localised context relevant to the Gas Import Jetty Works footprint and immediate surrounds, and included a general assessment of habitat suitability and occupancy. The surveys were conducted on foot from the shore using binoculars and spotting scopes.
b	Clarification as to how much of the site was surveyed (e.g. linear extent).	For each of the survey dates described, two sites were surveyed at high and low tide. Surveys were undertaken by walking along sections of coast near the Crib Point Jetty as follows: 1. From HMAS Otama Lookout Beach – approx 400 metres south to the Crib Point Jetty.

No.	Request	Response to request
		2. From Crib Point Jetty – approx 500 metres south Between high and low tide surveys at each site, additional sites in Hastings Bight were visited to gather context and opportunistic observations. These sites included Jacks Beach and Hastings. On the first survey, the Crib Point Jetty was accessed but was not accessed for subsequent surveys, as the Jetty was found not to provide any additional advantage for surveying wader habitat in the area.
c	Clarification as to the weather conditions during the survey (e.g. wind, rain, etc.)	Weather conditions were collected for each survey and did not present a limitation to survey.
d	Clarification as to the tide state during surveys (e.g. run in run out. slack tide or randomised).	Tide heights and notes were collected for each survey. Surveys were undertaken at both high and low tides as described in the report.
e	Clarification as to whether surveys were also done concurrently at control locations and, if so, how many sites/times and what were the counts there.	Concurrent surveys were not undertaken at control sites. As described above and in the report, shorebird values of Western Port are well documented. The additional surveys we undertook were not required, but were undertaken to provide some additional context and detail for the study area.
f	Clarification as to how long was spent at each site during each day of sampling.	The surveys at each site either side of the Crib Point Jetty were undertaken within a 2 hour timeframe, to coincide with the target tidal conditions
g	An explanation of what was done to assess the shoreline habitat values for shorebirds, for example, as per Zharikov and Milton (2009).1	This reference refers to a study that undertook a modelling exercise to determine factors influencing location of roost sites. This information (i.e. location of roost sites and key foraging areas) is already documented for Western Port and is summarised in the report and the studies referenced therein. Our surveys were also undertaken at night and during high tide to locate roosting habitat and roosting birds, the results of which are also described in our report.
h	Clarification as to whether the survey(s) were undertaken in accordance with the minimum data requirements in the EPBC Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species.	As noted in Section 4.1.4.2 of EES Technical Report B, Important habitats in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important. As a Ramsar site, Western Port is an internationally recognised area of important habitat for migratory shorebirds. This is supported by numerous studies and survey records over many years (Loyn et al. 2001, Dann et al. 2003, Kellogg Brown & Root 2010, Hansen et al. 2011, Menkhorst et al. 2014, Hale 2016, Melbourne Water 2018). As the importance of shorebird habitat within Western Port has already been recognised, and there is suitable, credible data available, further surveys were not necessary to establish its importance. This is consistent with EPBC Act Policy Statement 3.21 -

No.	Request	Response to request
		Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (Commonwealth of Australia 2017). Targeted surveys were undertaken to ascertain the types of habitat present in close proximity to the Gas Import Jetty Works study, assess their suitability for shorebirds and to document waterbird presence there.
i	Further information on the variability in abundance (at Crib Point and other areas for context), species richness and behaviours of migratory shorebirds.	This is addressed in Section 5.1.6 of EES Technical Report B.
j	A complete list of threatened shorebirds that have been identified as occurring of having potential to occur at Crib Point or the surrounding area.	This is documented in Table A2.2, which includes all threatened shorebirds recorded within 5km of the study area and an assessment of whether they are likely to be present within or adjacent to the study area. Those determined to have some potential to be present (i.e. medium or higher likelihood of occurrence, including those recorded during surveys) are discussed further in Section 5.1.4 of EES Technical Report B and listed in Table 18.
k	Further information and analysis of the impact of the Project on the Pacific Golden Plover (Pluvialis fulva) (EPBC Act-Migratory, Victoria Threatened Advisory list-Vulnerable), which has been twice ecorded at Crib Point on the Atlas of Living Australia (ala.org.au).	This species was assessed as having a lower likelihood of occurrence than those species that are discussed further in the report. This species has been assessed as having a low likelihood of occurrence in Table A2.2. There is one record from the VBA from 1973 from Crib Point, and the ALA has one from 1978.
2	Survey(s) of diving birds (e.g. species of cormorants and gulls) at that Crib Point Jetty, including the information requested in 1a-h.	No specific surveys for diving birds were undertaken, but they were recorded wherever observed, including during the wader and waterbird surveys, and listed in Table A2.1. Any threatened diving birds are listed in Table A2.2.
3	Nocturnal survey(s) of shorebirds and waterbirds.	A range of survey times were undertaken to determine values and presence of foraging or roosting waterbirds. Nocturnal survey was undertaken on 27 August for resident roosting waders and waterbirds. The survey sites were also assessed during dusk on 13 January 2020 at low tide, during dawn at high tide on 30 January 2020, and an hour before sunrise on 21 March 2019.
4	An assessment of the effects of lightning from the Project during operation on nocturnal birds.	See Section 7.2.1.4 of EES Technical Report B.
5	An assessment of the cumulative and interactive impacts of the Project on shorebirds, including and at a minimum, the cumulative and interactive effects of noise, boat wash and other disturbances	Section 7.12 of EES Technical Report A considers the potential accumulated impacts of key risks, which explains how the effects of the Project would interact with other stresses over time. Accumulated impacts were assessed for the four key issues of the FSRU

No.	Request	Response to request
	from the use of the Crib Point jetty by other vessels/operations and the Project vessels.	operation: (1) the discharge of cooler seawater from the regasification process, (2) the discharge of chlorinated seawater generated by electrolysis in the FSRU, (3) entrainment of plankton by the two main seawater intake sea chests on either side of the FSRU and (4) physical changes. The assessment uses the modelled predictions for when the FSRU is operating in open loop regasification mode.
6	An assessment of alternatives for the 'at sea' processes (i.e. what alternatives are possible for the operations proposed to be carried out using an open loop versus closed loop regasification process?)	This request is unclear, it reads as a request for an assessment of alternatives to regasification on the FSRU (ie an onshore regasification terminal). Technology options are considered in Section 2.5.1 of Chapter 2: Project rationale and includes consideration of onshore and offshore processing.
7	An updated and detailed mitigation and management program in relation to shorebirds, including: a. adaptive measures to be adopted during the waders and waterbirds monitoring program noted in the EMP and OEMP; and b. mechanisms for determining whether there will disruption to breeding, feeding, migration and resting of migratory shorebirds.	The Environmental Management Framework for the Project (EES Chapter 25) includes the following mitigation measure MM FF12: *The OEMP will include a monitoring program for waders and waterbirds at Woolleys Beach and Jacks Beach to allow for potential responses to the operation of the FSRU to be detected and, if appropriate, mitigated through an adaptive management response.* Mr Lane, in his expert witness statement, has proposed amendments to FF-12 to ensure adaptive management. Sections 4.3.2, 4.3.3 and 4.3.4 of the Inc Doc give effect to the EMP. Section 4.3.2 notes that the EMP will be prepared in consultation with MPSC, and Section 4.3.4 requires the proponent to outline consultation with relevant agencies (including DELWP) in development of the CEMP and OEMP. A Day One Incorporated Document will be provided which further addresses this issue.
8	An updated assessment of the limits of acceptable change (LAC) to critical components, process and services (CPS) in the context of the Crib Point Study area not only the entire Western Port Ramsar site.	Relevant studies in the EES and associated MNES report does not assess the LAC, rather it provides an assessment of the Project against the CPS for the Western Port Ramsar site having regard to the relevant LAC. There is no reasonable basis for an updated assessment and the query does not indicate which aspects of the assessment are not deemed current. . The assessment of the project regarding potentially significant effects on the Western Port Ramsar site having regard to the LAC considers all aspects of the Ramsar site, including the CPS at and in the vicinity of Crib Point.

No.	Request	Response to request
9	A comprehensive analysis of the effects on migratory shorebirds from human disturbance from current operations Crib Point jetty.	Current operations at Crib Point Jetty are considered as part of the existing conditions assessment presented in Technical Report B.
10	A comprehensive assessment of the potential impact of the Project on penguin populations on Phillip Island and Barralier Island.	EES Technical Report A: Marine biodiversity impact assessment includes a comprehensive assessment of the potential impacts on penguins from project operations. Section 7.7.8 and Table 7-15 of EES Technical Report A consider the potential for seawater temperature change from FSRU operations to impact on penguins and concludes there is no impact due to no temperature change reaching areas used by penguins. Penguins would readily be able to avoid the area where the guideline value for temperature is predicted to be exceeded. Section 7.8.14 and Table 7-22 of EES Technical Report A consider the potential for significant chlorine within seawater to impact on penguins and concludes there is no potential for impact. No chlorine is predicted to reach the areas used by penguins and penguins that did enter the area where the guideline value for chlorine is predicted to be exceeded. Penguins would readily be able to avoid the area where the guideline value for chlorine is predicted to be exceeded.

Attachment 3

AGL Gas Import Jetty Works

GHG Emissions Calculations - Construction Summary

Date	15/01/2020
Revision	R05
Completed By	DM
Checked By	AK, JH

Emissions Source	Project Activity	Total Emissions tCO2e		
		Scope 1	Scope 2	Scope 3
Stationary fuel	Fuel consumed by plant/equipment during topside jetty and FSRU construction works	3,059	-	157
Stationary fuel	Fuel consumed by plant/equipment during Crib Point Facility construction works	-	-	-
Transport fuel	Fuel consumed by employee air travel to and from project site	-	-	821
Transport fuel	Fuel consumed for FSRU vessel transportation to Crib Point (including relocation at end of operating life)	8,012	-	-
Transport fuel	Fuel consumed for material transportation to Crib Point	-	-	164
Transport fuel	Fuel consumed by vehicles / equipment during Crib Point Facility construction works	4,134	-	212
Transport fuel	Fuel consumed by employee travel to and from Crib Point project site	-	-	2,578
Purchased electricity	Electricity consumed by construction plant/equipment to build vessel			
Purchased electricity	Electricity consumed by site/project offices to build vessel			
Purchased electricity	Electricity consumed by construction plant/equipment to build onshore interface			
Purchased electricity	Electricity consumed by site/project offices to build onshore interface			
Embodied carbon in materials	Embodied carbon in vessel and plant materials			
Embodied carbon in materials	Embodied carbon in mooring infrastructure/unloading arms			
Embodied carbon in materials	Embodied carbon in steel and concrete	-	-	3,296
Carbon Sink	Carbon sequestration lost due to cleared land during construction	489.4	-	-
		15,695	**-**	**7,227**

AGL Gas Import Jetty Works

Stationary Fuel Emissions - Construction

Gas Import Jetty works stationary energy emissions		
Diesel Fuel		
S1	S2	S3
tCO_2-e		
634	-	33
1,268	-	65
119	-	6
549	-	28
386	-	20
103	-	5
3,059	**-**	**157**

Gas Import Jetty works stationary energy emissions								
Equipment Type	Equipment Fuel Demand	Equipment Power Demand	Qty	Operating days / year	Duration of use	Duration of program	Total Fuel demand	Energy Demand
	L/day	kW	#	day/annum	hrs/day	years	kL	GJ
Topside Jetty works								
Genset	100	na	5	312	na	1.50	234	9,032
Compressor	250	na	4	312	na	1.50	468	18,065
400Amp Welding Machines		32	3	312	10.5	1.50	na	1,698
Crib Point facilities								
Genset	100	na	5	270	na	1.50	203	7,817
Compressor	250	na	4	95	na	1.50	143	5,501
Welding Machines (assumed 400Amp)		32	3	270	10.5	1.50	na	1,470

AGL Gas Import Jetty Works

Transport Fuel Emissions - Construction

FSRU Transport from Korea to Crib Point		
Liquified Natural Gas		
S1	S2	S3
tCO_2-e		
8,012	-	-

FSRU Transport from Korea to Crib Point

Number of Cargos	Nautical Miles round trip	Transport Distance	Shipping Speed	Average Ship Speed	Days to transport	Fuel consumption (Fuel Oil)	Total Energy
#		km	knots	km/h	days	t/day	GJ
1	10,282	19,042	18	33	23.8	103.2	99,871

NOTE: this assumes return of vessel at end of operating life

Transport of Equipment to/from Crib Point		
Transport Fuel Oil & Diesel		
S1	S2	S3
tCO_2-e		
	-	-
	-	-
	-	-
	-	-
S1	S2	S3
tCO_2-e		
	-	-
	-	-
		72
		92
-	-	**164**

Transport of Equipment to Crib Point and Return

Equipment	Origin	Nautical Miles - Round trip	Transport Distance	Ship Type and DWT Weight	Cargo Weight	Shipping Speed	Average Ship Speed	Days to transport	Fuel consumption (Fuel Oil)	Total Energy used (ship)	Equip. Share of Fuel Consumption	Total Energy / Equipment Round Trip	Scope 3 Emissions	
-	-	nm	km	- / DWT	Tonne	knots	km/h	days	Tonne /day	GJ	GJ	GJ	tCO2-e	
MLA	France	23,962	44,378	Panamax New/120,000	121	17	31	58.7	103.0	237,993	0.1%	241	17.88	Not included as immaterial (<1%) of transport related emissions
Fire Pumps	India / Netherlands / USA	16,668	30,869	Panamax New/120,000	20	17	31	40.9	103.0	165,548	0.0%	28	2.09	Not included as immaterial (<1%) of transport related emissions
Odorant Vessels	Sth East China	10,180	18,853	Panamax New/120,000	14	17	31	25.0	103.0	101,109	0.0%	12	0.88	Not included as immaterial (<1%) of transport related emissions
Nitrogen Tank	Sth East China	10,180	18,853	Panamax New/120,000	1,530	17	31	25.0	103.0	101,109	1.3%	1,289	95.74	Not included as immaterial (<1%) of transport related emissions

Equipment	Origin	Number of Equipment	Return Distance	Total Transport Distance	Transport Mode	Fuel consumption	Total Fuel consumption	Fuel Energy Used	Scope 3 Emissions	
-	-	#	km	km	-	L/100km	kL	GJ	tCO2-e	
Air compressor	Sydney	2	1,918	1,918	Light commercial (diesel)	13	0.24	9	0.0335822	Not included as immaterial (<1%) of transport related emissions
Switchroom	Adelaide	1	1,606	1,606	Articulated Truck (diesel)	58	0.92	36	0.1283226	Not included as immaterial (<1%) of transport related emissions

116.23 Estimated 1% of total transport emissions

Delivery of steel	as per IS Materials calculator	Total tCO2-e	72
Delivery of concrete	as per IS Materials calculator	Total tCO2-e	92

Staff and construction worker transport		
Diesel		
S1	S2	S3
tCO_2-e		
-	-	2,413
-	-	165
-	-	**2,578**

Staff and construction worker transport

Origin	Destination	Return Distance	Percentage of workforce	Personnel	Project duration	Frequency of travel	Distance Travelled	Transport mode	Fuel consumption	Fuel consumption	Fuel Energy Used	
-	-	km	%	#	years	days/annum	km	-	L/100km	kL	GJ	Fuel type
Melbourne	Crib Point	162	90%	81	2.00	312	8,208,346	Car	10.8	887	34,219	Diesel
Dandenong	Crib Point	100	10%	9	2.00	312	561,600	Car	10.8	61	2,341	Diesel

Staff and construction air travel transport		
S1	S2	S3
tCO_2-e		
-	-	### ########

Staff and construction worker transport - flights

Origin	Destination	Journey	Personnel	Timeframe	Frequency	Total Journeys / Year	Emissions / Journey
-	-	Route	#	years	days/year	# / year	kg-Co2-3
Bris / Mel	Mel / Bris	Round-Trip	36	2.00	52	52	7,895

Crib Point Receiving Facility and Topside Jetty Transport Fuel emissions		
Diesel		
S1	S2	S3
tCO_2-e		
4,134	-	212

Crib Point Receiving Facility and Topside Jetty Transport Fuel emissions

Equipment Type	Equipment Fuel Demand	Qty	Frequency of Use	Duration of use	Duration of program	Total Fuel demand	Energy Demand
	L/day	#	day/annum	hrs/day	years	kL	GJ
Total for Crib Point Works						**1,526**	**58,895**
Sub total Topside Jetty works						**1,417**	**54,696**
Ute	35	6	208	10.50	1.50	66	2,529
EWP	50	2	277	10.50	1.50	42	1,606
10-tonne bollard pull tugs	100	3	277	10.50	1.50	125	4,817
aluminium crew boat	50	2	208	5.00	1.50	31	1,204
8-tonne truck	75	1	208	5.00	1.50	23	903
Forklift	40	1	208	10.50	1.50	12	482
20-tonne franna	125	1	208	10.50	1.50	39	1,505
40-tonne crane	125	1	208	8.00	1.50	39	1,505
Barge+600Tn Crane	250	1	2,496	8.00	1.50	936	36,130
Barge+250Tn Crane	250	1	277	8.00	1.50	104	4,014

AGL Gas Import Jetty Works
Transport Fuel Emissions - Construction

Construction emissions - Plant and equipment

	Fuel Consumption					Total Fuel Consumption	Energy Demand	Comment
	L/day				Total operating days	kL	GJ	
Subtotal Crib Point Facilitie					Summary Total	108.78	4,199	
Bulk Earthworks & Civils - Phase 1 (includes site establishment):								
Excavator	200				20	4		assumed 24T excavator
Tip trucks (Bardrill)	150				22	3.3		assumed 10T tipper
Roller	75				20	1.5		assumed compactor
Road trains	100				28	2.8		Semi trailer
Skid steer	100				20	2		skid truck
Grader	300				20	6		Cat 16M Grader
Utes	35				20	0.7		Ute 4x4
Loader	100				6	0.6		Cat 930 Loader
Bulk Earthworks & Civils - Phase 2:						0		
Plant Equipment					Total days (incl nitrogen)			
Skid steer	100				34	3.4		skid truck
Excavator	200				64	12.8		assumed 24T excavator
Roller	75				30	2.25		assumed compactor
Water truck	150				18	2.7		
Tip truck	150				50	7.5		assumed 10T tipper
Suck Truck	100				22	2.2		Vac truck
Utes	35				98	3.43		Ute 4x4
Piling Works:						0		
Plant Equipment					Total days (incl nitrogen)			
Skid steer	100				30	3		skid truck
Pile Rig	150				20	3		Cat 593 sideboom
Suck Truck	100				10	1		Vac truck
Fuel Trailer	100				18	1.8		Semi trailer
Welding truck	75				22	1.65		
Utes	35				94	3.29		Ute 4x4
SMPEI Works:						0		
Plant Equipment					Total days (incl nitrogen)			
Portable lunch room	-				224			assumed to be covered by Genset
Portable buildings	-				666			assumed to be covered by Genset
Toilet block	-				222			assumed to be covered by Genset
Genset					-			Included in stationary energy
Fuel cell	-				222			assumed to be covered by Genset
Water tank	-				434			assumed to be covered by Genset
Containers (1 Hazchem)	-				222			assumed to be covered by Genset
Site container / workshop & storage	-				654			assumed to be covered by Genset
Welding machines	-				-			Included in stationary energy
Utes	35				432	15.12		assumed to be covered by staff travel estimate
Bus	-				224			assumed to be covered by staff travel estimate
20T Franna Crane	22				182	4.004		
Manitou	100				182	18.2		skid truck
Light tower (on standby for shutdown)	-				4			assumed to be covered by Genset
Flange Facing Machine	30				4	0.12		Bending machine
25T Franna Crane	22				28	0.616		
Air Compressor	-				-			Included in stationary energy
Bob Cat	100				10	1		skid truck
Excavator	200				4	0.8		assumed 24T excavator

AGL Gas Import Jetty Works

Embodied Materials Emissions - Construction

AGL Jetty Topside Pipeline Embodied Carbon		
Embodied Carbon		
S1	S2	S3
tCO_2-e		
-	-	1,519
		1,777
-		**3,296**

AGL Jetty Topside Pipeline Embodied Carbon									
Component	Material	Outside Diameter	Wall thickness	Inside Diameter	Cross-section	Length	Volume	Density of Carbon Steel	Total Mass
		m	m	m	m^2	m	m^3	kg/m3	Tonnes
Pipeline	Sch80 Carbon Steel Pipe	0.61	0.031	0.548	0.056	1500	84.583	7850	664
		% SCM	m3	transport distance (km)		embedded emissions		tCO_2-e	Source
Concrete	Ready mix - 50 MPA	0	3,000	100		1,777			IS materials calculator

Refer to AGL IS_Materials_Calculator_Version 1-2 2018-10-26 (locked))

AGL Gas Import Jetty Works

Carbon Sink - Construction

					Carbon Sink		
Ecological Vegetation Class	Area to be cleared	Vegetation Class	Biomass Max Class	Carbon Value	S1	S2	S3
	ha			tCO_2-e/ha	tCO_2-e		
Damp sands herb-rich woodlands	0.00	I	4	110.0	0		
Heathy woodland	1.57	H	2	309.0	486		
Swamp scrub	0.03	I	4	110.0	3		
Swampy riparian woodland	0.00	D	3	307.0	0		
Grassy woodland	0.00	D	3	307.0	0		
Damp heathy woodland	0.00	H	2	309.0	0		
Tall marsh	0.00	I	4	110.0	0		
Swampy woodland	0.00	D	3	307.0	0		
Estuarine Scrub	0.00	I	4	110.0	0		
	0.00						
Total	**1.60**				**489**	**0**	**0**

AGL Gas Import Jetty Works
GHG Emissions Calculations - Operations Summary

Date 15/01/2020
Revision R05
Completed By DM
Checked By AK, JH

Emissions Source	Project Activity	Closed Loop			Open Loop		
		Total Annual Emissions tCO_2e			Total Annual Emissions tC_O2e		
		Scope 1	Scope 2	Scope 3	Scope 1	Scope 2	Scope 3
Stationary fuel	Fuel consumed by the FSRU during operation	236,144.7	-	-	55,572	-	-
Stationary fuel	Venting (not included)	-	-	-	-	-	-
Transport fuel	Fuel consumed by LNG carriers for transport of cargo to Crib Point	-	-	388,916.5	-	-	388,917
Transport fuel	Transport fuel emissions during operation of Crib Point Facilities	23	-	143.8	23	-	144
Transport fuel	Fuel consumed by tug boats mooring the LNGCs at Crib Point				-	-	-
Transport fuel	Fuel consumed by supply delivery vehicles to the FSRU				-	-	-
Transport fuel	Fuel consumed by employee travel to and from site	-	-	458.4	-	-	458
Transport fuel	Fuel consumed by AGL operational vehicles				-	-	-
Purchased electricity	Electricity used in Crib Point Facilities	-	2,159	211.7	-	2,159	212
Purchased electricity	Electricity used in AGL offices for operations of the FSRU				-	-	-
Fugitive emissions	Fugitive emissions from transfer of LNG from carrier to FSRU	1,882	-	-	1,882	-	-
Fugitive emissions	Fugitive emissions from the FSRU to Crib Point transfer pipeline	0	-	-	0	-	-
Fugitive emissions	Fugitive emissions from the Crib point facilities	29	-	-	29	-	-
Waste emissions	Emissions from the disposal of municipal solid waste				-	-	-
Waste emissions	Emissions from liquid waste products - sewerage				-	-	-
Total Emissions	**AGL**	**238,079**	**2,159**	**389,730**	**57,506**	**2,159**	**389,730**
	APA	**8,780**	**918**	**751**	8,780	918	751
	Total Project (tCo2-e)	**246,859**	**3,077**	**390,482**	**66,286**	**3,077**	**390,482**
			249.9	640.4		69.4	459.8
	% of Victorian emissions		0.23%	0.58%	0.00%	0.06%	0.42%

AGL Gas Import Jetty Works

Stationary Fuel Emissions - Operations

		Total FSRU Operations			FSRU Reciprocating Engines & Boilers			Operation														Ship Demand								
		Fuel Gas			Fuel Gas																	While unloading	Not unloading	While unloading		Not unloading				
Scenario (Send out rates)	Operation	S1	S2	S3	S1	S2	S3	Send Out rate	Total LNG Cargos	Time to unload 1 cargo	Annual time unloading	Annual time not unloading	Operational Days	Operational Hours	Lean LNG Cargos	Rich LNG Cargos						Fuel demand - FSRU engine and boiler (NG)	Fuel demand - FSRU engine and boiler (NG)	Total Fuel Demand - NG		Total Fuel Demand - NG		Gas consumed per annum	Gas Density - NG	Gas Energy Content - NG	Gas consumed per annum
Closed Loop		tCO_2-e			tCO_2-e			#	#	hrs	days/annum	days/annum	days/annum	hrs/day	#	#						tonnes/h	tonnes/h	kg/annum	m3/annum	kg/annum	m3/annum	t/annum	kg/m3	GJ/m3	GJ/annum
387	Closed Loop	132,672	-	-	132,672	-	-	387	20	36	30.00	183.00	213	24	20	-						**10.42**	**10.21**	7,502,400		44,842,320		52,345	0.799	0.0393	2,574,653
500	Closed Loop	76,078	-	-	76,078	-	-	500	16.0	36	24.00	98.00	122	24	11	5						**10.42**	**10.21**	6,001,920		24,013,920		30,016	0.799	0.0393	1,476,374
750	Closed Loop	27,395	-	-	27,395	-	-	750	4.0	36	6.00	24.00	30	24	3	1	CLOSED					**15.18**	**14.97**	2,185,920		8,622,720		10,809	0.799	0.0393	531,639
Open Loop		**236,145**	**-**	**-**																								**93,169**			**4,582,665**
387	Open Loop	31,479	-	-	31,479	-	-	387	20	36	30.00	183.00	213	24	20	-						**2.61**	**2.4**	1,879,200		10,540,800		12,420	0.799	0.0393	610,896
500	Open Loop	18,118	-	-	18,118	-	-	500	16.0	36	24.00	98.00	122	24	11	5						**2.61**	**2.4**	1,503,360		5,644,800		7,148	0.799	0.0393	351,593
750	Open Loop	5,975	-	-	5,975	-	-	750	4.0	36	6.00	24.00	30	24	3	1	OPEN					**3.33**	**3.26**	479,520		1,877,760		2,357	0.799	0.0393	115,946
		55,572	**-**	**-**																								**21,925**			**1,078,435**
Combined (as per Open loop with two additional boilers)																														
N/A	Total Open Loop Emissions	55,572	-	-	55,572	-	-	N/A	40	36	60	305	365	24	34	6								3,862,080		18,063,360	-	21,925	0.799	0.0393	1,078,435
N/A	Additional boilers	17,373	-	-	17,373	-	-	N/A	N/A	N/A	N/A	30	30	24	N/a	N/a						**N/A**	**9.52**	-		6,854,400	-	6,854	0.799	0.0393	337,144
		72,945																										**28,780**			**1,415,579**

Operation - Venting		
Fuel Gas		
S1	S2	S3
tCO2-e		
17	**-**	**-**

Not included as immaterial (<1%) of operational emissions

Operation - Venting								
Jetty Piping length	Inner diameter	Total volume	Pressure	Total vented volume	Total Energy per event	Assumed number of events in 20 years	Total over 20 years	Annualised venting allowance
km	m	m3	kpa	m3	GJ	#		
1.8	0.5	424.5	10,200.0	42,747.4	1,680.0	4	6,720	336

AGL Gas Import Jetty Works

Purchased Electricity Emissions - Operations

		Crib Point Receiving Facility			Crib Point Nitrogen Facility		
		Grid Electricity			Grid Electricity		
	Operation	S1	S2	S3	S1	S2	S3
		tCO_2-e/annum			tCO_2-e/annum		
		-	782	77	-	-	-
		-	448	44	-	653	64
		-	110	11	-	165	16
Total		**-**	**1,340**	**131**	**-**	**819**	**80**

Activity Data										
Operation					Crib Point Facility			Crib Point Nitrogen Facility		
Total Cargoes @ send out	Lean	Rich	Operational Days	Operational Hours	Plant, Control and Odorant Facility	Hours of Operation	Electrical Energy Demand	Peak Energy Demand	Operational Hours	Energy Demand
			days/annum	hrs/day	kW	hrs/annum	kWh/annum	kW	hrs/annum	kWh/annum
387	20	-	213	24	150	5,112	766,800	500	0	-
500	11	5	122	24	150	2,928	439,200	700	915	640,500
750	3	1	30	24	150	720	108,000	900	180	162,000
	34	**6**	**365**							

AGL Gas Import Jetty Works

Transport Fuel Emissions - Operations

LNG Carrier Transport Fuel Emissions		
Liquified Natural Gas		
S1	S2	S3
tCO_2-e		
-	-	388,917

First two Years FSRU operators and staff transport		
Diesel		
S1	S2	S3
tCO_2-e		
-	-	683
-	-	238
Jet fuel		
S1	S2	S3
tCO_2-e		
-	-	462

Two -Twenty Years FSRU operators and staff transport		
Diesel		
S1	S2	S3
tCO_2-e		
-	-	4,814
-	-	2,971
Total		
S1	S2	S3
tCO_2-e		
-	-	9,169
Annual Average		
S1	S2	S3
tCO_2-e		
-	-	458.43

Nitrogen Delivery Vehicles			General Staff Movements			Odorant Delivery Vehicle		
Diesel			Diesel			Diesel		
S1	S2	S3	S1	S2	S3	S1	S2	S3
tCO_2-e			tCO_2-e			tCO_2-e		
-	-	142	23.5	0.0	1.2	-	-	0.69

LNG Carrier Transport Fuel Emissions

Number of Cargos	Nautical Miles round trip	Transport Distance	Shipping Speed	Average Ship Speed	Days to transport	Fuel consumption - LNG	Total LNG Fuel Used	Total MDO pilot fuel used	Total MDO pilot fuel used	Total MDO pilot fuel used
#		km	knots	km/h	days	mmbtu/trip	mmbtu/annum	tonnes/trip	t/annum	GJ/annum
40	12,824	23,750	17	31	1,257.3	160,625	6,425,000	34	1,376	55,948.16

First Two Years

Origin	Destination	Return Distance	Personnel	Timeframe	Frequency of travel	Total Distance Travelled	Transport mode	Fuel consumption	Fuel consumption	Fuel Energy Used
-	-	km	#	years	days/annum	km	-	L/100km	kL	GJ
Melbourne	Crib Point	162	23	2	312	2,325,024	Passenger car (di	11	251.10	9,693
Dandenong	Crib Point	100	13	2	312	811,200	Passenger car (di	11	87.61	3,382

Origin	Destination	Journey	Personnel	Timeframe	Flights per change out	Frequency of change out	Total flights per year	Emissions / Passenger / Journey
-	-	Route	#	years	#	#	# / year	kg- Co2-e
Oslo / Mel	Mel / Oslo	Via Dubai	10	2	2	11	220	1,049

Two - Twenty Years

Origin	Destination	Return Distance	Personnel	Timeframe	Frequency of travel	Total Distance Travelled	Transport mode	Fuel consumption	Fuel consumption	Fuel Energy Used
-	-	km	#	years	days/annum	km	-	L/100km	kL	GJ
Melbourne	Crib Point	162	18	18	312	16,376,256	Passenger car (diesel)	10.8	1,768.64	68,269
Dandenong	Crib Point	100	18	18	312	10,108,800	Passenger car (diesel)	10.8	1,091.75	42,142

Activity Data

Nitrogen Delivery Vehicles							General Staff Movements							Odorant Delivery Vehicle						
Return distance	Trucks per year	Total Distance	Fuel Economy	Fuel Consumption	Fuel Energy	Total Fuel Energy	Return distance	Frequency	Total Distance	Fuel Economy	Fuel Consumption	Fuel Energy	Total Fuel Energy	Return distance	Frequency	Total Distance	Fuel Economy	Fuel Consumption	Fuel Energy	Total Fuel Energy
km/trip	trips/year	km/year	L/100km	L	GJ/kL	GJ	km/trip	trips/year	km/year	L/100km	L	GJ/kL	GJ	km/trip	trips/year	km/year	L/100km	L	GJ/kL	GJ
220.00	50	11,000	62.0	6,820	38.60	263	180	104	18,720	9	1,722.24	38.60	66.48	92.2	6	553	46	254.47	38.60	9.82
86.00	850	73,100	62.0	45,322	38.60	1,749	50	1,500	75,000	9	6,900.00	38.60	266.34							

AGL Gas Import Jetty Works

Fugitive Emissions - Operations

LNGC to FSRU unloadinging			Topside Jetty Infrastructure			Crib Point Metering & Odorant Plant		
Fugitive			Fugitive			Fugitive		
S1	S2	S3	S1	S2	S3	S1	S2	S3
tCO_2-e			tCO_2-e			tCO_2-e		
1,882	**-**	**-**	**0.5**	**-**	**-**	**29**	**-**	**-**

LNGC to FSRU unloadinging				
Total LNG Cargos	Annual unloading time	Unloading hoses	Return hoses	Total connections
#	hrs/annum	#	#	#
40	**1,440**	**4.00**	**2.00**	**12.00**

FSRU Plant
Operational Hours
hrs
8,760

Topside Jetty Infrastructure	
Pipeline Length	Operational Hours
km	hrs
1.80	**8,760**

Crib Point Metering & Odorant Plant	
No of Plants	Operational Hours
#	hrs
1	8,760

AGL Gas Import Jetty Works
GHG Emissions Factors

National Greenhouse Account Factors - August 2019
Australian Government - Department of the Environment and Energy

2.1 Stationary Energy emissions (non-transport)
2.1.2 Fuel combustion emissions - gaseous fuels

Fuel combusted	Energy content factor GJ/m3	Emission factor (kg CO_2e/GJ)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Natural gas distributed in a pipeline	0.0393	51.40	0.10	0.03	51.53	0.00	3.90
Liquefied natural gas	25.3	51.40	0.10	0.03	51.53	0.00	0.00

2.1.3 Fuel combustion emissions - liquid fuels

Fuel combusted	Energy content factor GJ/kL	Emission factor (kg CO_2e/GJ)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Diesel oil	38.60	69.90	0.10	0.20	70.20	0.00	3.60
Petroleum based products other than m	34.40	69.80	0.00	0.20	70.00	0.00	3.60

2.2 Transport fuel emissions (post-2004)

Fuel combusted	Energy content factor GJ/kL	Emission factor (kg CO_2e/GJ)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Gasoline (other than for use as fuel in a	34.20	67.40	0.02	0.20	67.62	0.00	3.60
Diesel oil	38.60	69.90	0.01	0.60	70.51	0.00	3.60
Liquefied petroleum gas	26.20	60.20	0.40	0.30	60.90	0.00	3.60
Fuel Oil	39.70	73.60	0.07	0.60	74.27	0.00	3.60

2.3 Indirect emissions from electricity

State or Territory		Emission factor (kg CO2e/kWh)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Victoria					0.00	1.02	0.10

2.4.2.7 Natural gas transmission
Transmission mains are defined as high-pressure pipelines greater than 1050 kilopascals, as used in the Energy Supply Association of Australia natural gas statistics.

Operation or process source		Emission factor (tonnes CO_2-e/km pipeline length)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Natural gas transmission tCO2e/km pipe		0.02	10.40	0.00	10.42	0.00	0.00
Gas flared tCO2e/t flared		2.70	0.10	0.03	2.83	0.00	0.00

3.19 Industrial processes - emissions of hydroflurocarbons and sulphur hexaflouride gases

Equipment type	Default HFCs annual leakage rates of gas			
Commercial air conditioning—chillers	0.09			
Commercial refrigeration - supermarket systems	0.23			
Industrial refrigeration including food processing and cold storage	0.16			

Appendix 4 - Emissions from waste disposal to landfill and wastewater treatment

Operation or process source		Emission factor (t CO_2-e/t waste)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Municipal solid waste							1.4
Commercial and industrial waste							1.2
Construction and demolition waste							0.2

API Compendiminium

Table 6-6. Fugitive emissions factors for natural gas transmission and storage equipment (American Petroleum Institute (API), Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry, p6-17)

Equipment basis	Units	Emission factor					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
					CO_2-e		
Compressor stations	t/station-hr		0.0070200		0.1755000000		
Storage Stations	t/station-hr		0.0172000		0.4300000000		
Metering/regulation stations	t/station-hr		0.0001310		0.0032750000		
Metering/regulation stations transmissio	t/station-hr		0.0031800		0.0795000000		
Gas transmission pipeline	**t/km-hr**	**2.93E-07**	**1.20E-06**		**3.03E-05**		
CO2 from oxidation	t/km-hr	2.44E-07			2.44E-07		
CO2 from leaks	t/km-hr	4.89E-08			4.89E-08		

Table 13. Default Methane Emission Factors per Component Population For LNG Storage and Import/Export Terminals
(American Petroleum Institute (API), 2015, Liquefied Natural Gas (LNG) Operations Consistent Methodology for Estimating Greenhouse Gas Emissions (api-lng-ghg-emissions-guidelines-05-2015.pdf, p61)

Equipment basis	Units	scf	m3		tCO_2-e/hr/component
Valve	scf/hour/component	1.19	0.0336971		0.381189471
Pump Seal	scf/hour/component	4	0.1132674		1.281309146
Connectors, flanges, threaded fittings	scf/hour/component	0.34	0.0096277		0.108911277
Other	scf/hour/compressor	1.77	0.0501208		0.566979297
Vapor Recovery Compresssors	scf/hour/compressor	4.17	0.1180813		1.335764784

Source: (American Petroleum Institute (API), 2015, Liquefied Natural Gas (LNG) Operations Consistent Methodology for Estimating Greenhouse Gas Emissions (api-lng-ghg-emissions-guidelines-05-2015.pdf, p61)

Appendix B - Unit Conversion		
From	Multiply by	to obtain
Average Emissions		
Combustion of 1 tonne of LNG	2.5372	t CO_2

AGL Gas Import Jetty Works
GHG Emissions Factors

Table 15. GHG Emission Factors for Combustion of Fuels for LNG Transportation

Operation or process source	Units	Emission factor					
		CO_2	CH_4	N_2O			CO_2-e
Ocean Tanker							
Bunker fuel	tonnes/TJ	80.11	0.00434				80.2185
Diesel	tonnes/TJ	73.59	0.00434				73.6985
Natural Gas / Boil-off gas	tonnes/TJ	54.57	0.08684				56.741
Ocean Tanker							
Bunker fuel	tonnes/Mmbtu	0.0845	0.0000046				0.084615
Diesel	tonnes/Mmbtu	0.0776	0.0000046				0.077715
Natural Gas / Boil-off gas	tonnes/Mmbtu	0.0576	0.0000916				0.05989

Source: (American Petroleum Institute (API), 2015, Liquefied Natural Gas (LNG) Operations Consistent Methodology for Estimating Greenhouse Gas Emissions (api-lng-ghg-emissions-guidelines-05-2015.pdf, p61)

Embodied Carbon in Materials - ISCA Materials Calculator	
	tCO2/tonne of material
Carbon Steel Pipe	2.2878315

Source: version # IS_Materials_Calculator_Version 1-2 2018-10-26 (locked)

Heogh Speed / Fuel consumption of FSRU

Source: Hoegh Giant FORM C (002).pdf		
	Maximum fuel consumption (kg/hour)	
Speed (knots)	Laden	Ballast
13.5	2700	2600
16	3700	3500
18	4600	4300

Fuel properties

Source: DEFRA 2019		
Fuel Type		Unit conversion
Fuel Oil	40.66	GJ/tonne
LNG	452.49	kg/m^3
Natural Gas	0.799	kg/m^3

Air travel

Source: DEFRA 2019 International non-uk Economy (with Radiative forcing)	
0.138445	kg/km

Fuel combustion emission factors (transport energy)

Source: NGAF - https://www.environment.gov.au/climate-change/climate-science-data/greenhouse-gas-measurement/publications/national-greenhouse-accounts-factors-august-2019		
Fuel Type	Energy content factor	Unit
Fuel Oil	39.7	GJ/kL
	39.3	GJ/Tonne

https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-approximate-conversion-factors.pdf

Emission factor (kg CO_2e/GJ)					
CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
73.60	0.07	0.60	74.27	0.00	3.60

a. Fuel Burn information provided are for 1 aircraft per leg

b. Aircraft Fuel Burn/journey = ∑Aircraft Fuel Burn/leg

c. Total passengers' CO2/journey = ∑Passenger CO2/pax/leg×Number of pax

AGL Gas Import Jetty Works
GHG Emissions Factors

One Way/Round Trip	Cabin Class	Number of Passengers
One Way	Economy	1

Leg	From City/Airport	To City/Airport
1	OSL	DXB
2	DXB	MEL
Delete All Location(s)	Delete Leg	Add New Leg

Reset | Compute

Metric (KG / KM) | **Standard** (LBS / MI)

Total

Dep Airport	Arr Airport	Number of passengers	Cabin Class	Trip	Aircraft Fuel Burn/journey (KG)[ab]	Total passengers' CO2/journey (KG)[c]
OSL	MEL	1	Economy	One Way	233998.3	1049.0

Flight Stage Detail

Dep Airport	Arr Airport	Distance (KM)	Aircraft	Aircraft Fuel Burn/leg (KG)[a]	Passenger CO_2/pax/leg (KG)
OSL	DXB	5134.0	73H, 77W	45696.4	308.7
DXB	MEL	11639.0	388	188301.9	740.3

a. Fuel Burn information provided are for 1 aircraft per leg

b. Aircraft Fuel Burn/journey = ∑Aircraft Fuel Burn/leg

c. Total passengers' CO2/journey = ∑Passenger CO2/pax/leg×Number of pax

Attachment 4

APA Pipeline Works

GHG Emissions Calculations - Construction Summary

Date 15/01/2020
Revision R05
Completed By DM
Checked By AK, JH

Emissions Source	Project Activity	Total Emissions		
		Scope 1	Scope 2	Scope 3
Stationary fuel	Fuel consumed by construction plant/equipment	1,051	-	54
Transport fuel	Fuel consumed by project vehicles during pipeline and plant construction works	5,851	-	299
Transport fuel	Fuel consumed by employee travel to and from Crib Point/Pakenham project site	-	-	490
Transport fuel	Fuel consumed by vehicles transporting material to site (steel and concrete)	-	-	1,152
Purchased electricity	Electricity consumed by construction plant/equipment			
Purchased electricity	Electricity consumed by site/project offices			
Embodied carbon in materials	Embodied carbon in Crib Point Pakenham steel transmission pipeline	-	-	24,481
Embodied carbon in materials	Embodied carbon in concrete/cement used in construction	-	-	237
Carbon Sink	Carbon sequestration lost due to cleared land during construction	3,887	-	-
Total Emissions		**10,790**	**-**	**26,713**

APA Pipeline Works

Stationary Fuel Emissions - Construction

Pipeline and Pakenham facilities stationary energy emissions		
Diesel Fuel		
S1	S2	S3
tCO_2-e		
677	-	35
163	-	8
93	-	5
118	-	6
1,051	**-**	**54**

Pipeline and Pakenham facilities stationary energy emissions							
Equipment Type	Equipment Fuel Demand	Equipment Power Demand	Qty	Frequency of Use	Duration of use	Total Fuel demand	Energy Demand
	L/day	kW	#	Total days	hrs/day	kL	GJ
Genset (site establishment)	500	na	1	500	na	250	9,650
Genset (SMPEI)	500	na	1	120	na	60	2,316
Genset (Watercourse bore)	500	na	1	69	na	34.50	1,332
Genset (Major HDD)	500	na	1	87	na	43.50	1,679

APA Pipeline Works

Transport Fuel Emissions - Construction

Delivery of Materials	GHG	Reference
-	tCO_2-e	
Delivery of steel	**1151.6**	refer to : APA IS_Materials_Calculator_Version 1-2 2018-10-26 (locked)
Delivery of concrete	**0.3**	refer to : APA IS_Materials_Calculator_Version 1-2 2018-10-26 (locked)

											Construction Vehicles		
											Diesel Oil		
Project	Construction Phase	Personnel Description	# of Units	Equipment	Days	Fuel Consumtion	Total Fuel Consumption	Hours of Operation	Works Description	Fuel Energy	S1	S2	S3
						L/day	L	hrs		GJ	tCO_2-e		
							2,149,740	**247,877**		**82,980**	**5,850.92**	**-**	**298.73**
Pipeline+MLV	Project Management	Project Manager	1	4x4 wagon	176	30	5280	1496	6km/ltr light vehicles				
		Construction Manager	1	4x4 wagon	176	30	5280	1496					
		Superintendent	1	4x4 wagon	176	30	5280	1496					
		Engineering Manager	1	ute 4x4	176	35	6160	1496					
		Site Engineer	3	ute 4x4	176	35	18480	4488					
		Safety Manager	1	4x4 wagon	176	30	5280	1496					
		Safety Officer	1	ute 4x4	176	35	6160	1496					
		Environmental Manager	1	ute 4x4	176	35	6160	1496					
		Environmental Officer	2	ute 4x4	176	35	12320	2992					
		QA Manager	1	4x4 wagon	176	30	5280	1496					
		QA Inspector	8	ute 4x4	176	35	49280	11968					
		Landowner Liasion	1	ute 4x4	176	35	6160	1496					
		Commercial Manager	1		176			1496	Assume no travel associated with role				
		Contracts Officer	1		176			1496	Assume no travel associated with role				
		Administration	2		176			2992	Assume no travel associated with role				
	Fencing	Labour	3	ute 4x4	55	35	5775						
		Operator	1	Tractor Post Driver	55	40	2200						
		Operator	2	10T truck	55	75	8250						
	Access and ROW Maintenance	Foreman	1	ute 4x4	55	35	1925	467.5					
		Operator	1	140G Grader	55	225	12375	467.5					
		Operator	1	Backhoe	55	75	4125	467.5					
		Operator	1	Compactor	55	75	4125	467.5					
		Operator	1	water cart	55	150	8250	467.5	15000 ltr water cart				
		Labour	1	ute 4x4	55	35	1925						
	Tree Clearing	Foreman	1	ute 4x4	20	35	700	170					
		Leading hand	1	ute 4x4	20	35	700	170					
		Operator	1	24T Excavator	20	200	4000	170	Supplied with various attachments: Bucket/grab/root grinder				
		Operator	1	Hiab	20	100	2000	170					
		Fauna Handler	1	ute 4x4	20	35	700	170					
		Operator	1	Mulcher	20	50	1000	170					
	Environmental Controls	Foreman	1	ute 4x4	110	35	3850	935					
		Operator	1	Backhoe	110	75	8250	935					
		Operator	1	140G Grader	110	225	24750	935	Operating Weight 22T				
		Labour	1	Crew cab truck	110	40	4400	935	Installing silt fence, filter socks etc.				
	Clear & Grade	Foreman	1	ute 4x4	69	35	2415	586.5					
		Leading hand	1	ute 4x4	69	35	2415	586.5					
		Operator	1	Hitachi 30t Exc	69	225	15525	586.5					
		Operator	1	Cat 16M Grader	69	300	20700	586.5	Operating Weight 32T				
		Operator	1	Cat 14M Grader	69	225	15525	586.5	Operating Weight 25T				
		Operator	1	Cat D6 Dozer	69	200	13800	586.5	Operating Weight 21T				
		Labour	1	ute 4x4	69	35	2415	586.5					
		Operator	1	Cat 30T Moxy	69	200	13800	586.5	Operating Weight 28T/Capacity 15cu.m				
	Pipe Yard	Foreman	1	ute 4x4	69	35	2415	586.5					
		Operator	1	Hitachi 30t Exc	69	225	15525	586.5	Vacuum lift attachment				
		Operator	6	Ext trailer	69	100	41400	3519	Transport pipe from stockpile; Prime Mover and 18m extendable trailer				
	Strining and Bending	Stringing Foreman	1	ute 4x4	69	35	2415	586.5					
		Operator	1	Hitachi 30T Exc	69	225	15525	586.5	Vacuum Lift attachment				
		Operator	1	Skid Truck	138	100	13800	1173	Deliver skids and bags(2 skids&bags/pipe)				
		Operator	1	Skid Truck	138	100	13800	1173	Deliver skids for welding (approx 500/km)				
		Leading Hand	1	ute 4x4	69	35	2415	586.5	Measuring in pipe mark bends; Sag and Overbends to suit ground level				
		Bending Engineer	1	ute 4x4	69	35	2415	586.5					
		Operator	1	CRC Bending Machine	69	30	2070	586.5					
		Operator	1	Cat 572 Sideboom	69	125	8625	586.5	Operating Weight 31T/Lifting capacity 40T				
		Labour	2	ute 4x4	69	35	4830	1173	Assist with bending				
		Operator	1	15,000ltr water cart	69	150	10350	586.5					
	Mainline Welding	Operator	1	Cat 561 Sideboom	55	75	4125	467.5	Operating Weight 18T/ Lifting capacity 18T; Setting in pipe				
		Operator	1	Tac Rig	55	200	11000	467.5	Welding machines/ compressor for clamp				
		Operator	2	10T Truck	55	75		935	Root run (Bead hands)				
		Welder	2	Welding Truck	55	75	8250	935	Fill and Cap				
		Operator	1	15,000ltr water cart	55	150	8250	467.5					
	Non-destructive testing	NDT supervisor	1	ute 4x4	55	35	1925	467.5	Processing lab at Contractor Site				
		Technician	1	ute 4x4	55	35	1925	467.5	Maintaining and operating Internal Crawler				
		Technician	1	ute 4x4	55	35	1925	467.5	External radiography; Mobile Darkroom for processing onsite				
		Technician	1	ute 4x4	125	35	4375	1062.5	External radiography; NDD for Tie In welding				
	Coating	Foreman	1	ute 4x4	55	35	1925	467.5					
		Leading Hand	1	ute 4x4	55	35	1925	467.5					
		Operator	1	Blast truck/including compressor	55	350	19250	467.5	Truck fitted with 350 compressor and blast pot; Hiab truck can load grit etc.				
		Operator	1	Spray truck	55	75	4125	467.5	Truck fitted with spray unit				
		Labour	1	ute 4x4	55	35	1925	467.5	Mask up joints for coating/assist coaters				
		Coater	1	Hiab truck/including compressor	55	350	19250	467.5	Mobile truck for coating Tie Ins; Truck fitted with blast unit				
		Operator	1	15,000ltr water cart	55	150	8250	467.5					
	Trenching	Foreman	1	ute 4x4	55	35	1925	467.5					
		Leading Hand	1	ute 4x4	55	35	1925	467.5					
		Operator	2	Hitachi 35T Exc	55	225	24750	935	Excavation of side bends/bell holes/services; Attachments Montaberg hammer, rock pick				
		Operator	1	Bucket Wheel Trencher 780	55	300	16500	467.5	Trencor Jetco 780 Operating weight 34T; 4x4 ute with each trenching machine				
		Operator	1	Bucket Wheel Trencher 1075	55	300	16500	467.5	Tesmec 1075/ Operating weight 39T				
		Operator	1	Chain Trencher	55	400	22000	467.5	Vermeer T955 / T1055; Operating weights 955/38T 1055/ 42T				
		Labour	2	ute 4x4	55	35	-	935	Included in travel to / from site: Assist excavators and trenchers				
		Boilermaker	1	Hiab truck	55	100	5500	467.5	Maintenance trenchers				
	Lower In	Foreman	1	ute 4x4	55	35	1925	467.5					
		Leading Hand	1	ute 4x4	55	35	1925	467.5					
		Operator	1	Cat 572 Sideboom	55	125	6875	467.5	Pre jeeping pipe for coating defects; Operating Weight 31T/ Lifting capacity 40T				
		Operator	2	Hitachi 35T Exc	55	225	24750	935	Ditch Prep/ clean out excavate crossings				
		Operator	1	Superior 250 Padder	55	250	13750	467.5	Padding machine for bottom padding				
		Operator	1	Superior 350 Padder	55	300	16500	467.5	Padding machine for top padding				
		Operator	2	Cat 572 sideboom	55	125	13750	935	Lower in pipe; Operating Weight 31T/ Lifting capacity 40T				
		Operator	1	Cat 583 sideboom	55	150	8250	467.5	Lower in pipe; Operating Weight 50T/ Lifting capacity 75T				
		Operator	1	15,000ltr water cart	55	150	8250	467.5					
	Backfill	Foreman	1	ute 4x4	55	35	1925	467.5					
		Leading Hand	1	ute 4x4	55	35	1925	467.5					
		Operator	1	Cat D6 dozer	55	200	11000	467.5	Operating Weight 21T				
		Operator	1	Cat 16M Grader	55	300	16500	467.5	Operating Weight 32T				
		Operator	1	Cat 14M Grader	55	225	12375	467.5	Operating Weight 25T				
		Operator	1	Cat 930 Loader	55	100	5500	467.5					
		Operator	1	Hitachi 35T Exc	55	225	12375	467.5					
		Labour	2	ute 4x4	55	35	3850	935	Install marker tape/check padding depth				
	Specials RVX, RDX and Tie Ins (Lower In)	Foreman	1	ute 4x4	110	35	3850	935					
		Leading Hand	1	ute 4x4	110	35	3850	935					
		Operator	3	Hitachi 35T Exc	110	225	74250	2805					
		Operator	3	Cat 572 sideboom	110	125	41250	2805	Operating Weight 31T/ Lifting capacity 40T				
		Labour	2	ute 4x4	110	35	7700	1870					
		Operator	1	Cat 30T Moxy	110	200	22000	935					
		Welder	2	Welding Truck	110	75	16500	1870					
	Street Works Hastings	Foreman	2	ute 4x4	74	35	5180	1258					
		Leading Hand	2	ute 4x4	74	35	5180	1258					
		Operator	1	Hitachi 30T Exc	74	225	16650	629					
		Labour	2	ute 4x4	74	35	5180	1258	Saw Cutting Bitumen				
		Operator	1	12 Ton Tipper	74	75	5550	629					
		Labour	1	Hiab Truck	74	100	7400	629					
		Welder	1	Welding Rig	74	75	5550	629					
		Operator	1	Street Sweeper	74	100	7400	629					
	Rail Bore	Equipment	1	Auger Bore	27	500	13500	229.5	Cased crossing; Concrete Jacking pipe				
		Foreman	1	ute 4x4	27	35	945	229.5					
		Operator	1	Hiab Truck	27	100	2700	229.5					
		Operator	1	30T Exc	27	225	6075	229.5					
	Road Bore	Operator	1	Mini HDD	69	350	24150	586.5	Vermeer D36 x 50 Drill Rig				
		Operator	1	Semi Trailer	69	100	6900	586.5					
		Foreman	1	ute 4x4	69	35	2415	586.5	Semi Trailer for transport of equipment				
		Operator	1	30T Exc	69	225	15525	586.5	Excavation of Bell holes				
		Foreman	1	ute 4x4	110	35	3850	935					

APA Pipeline Works

Transport Fuel Emissions - Construction

Delivery of Materials	GHG	Reference
-	tCO_2-e	
Delivery of steel	**1151.6**	refer to : APA IS_Materials_Calculator_Version 1-2 2018-10-26 (locked)
Delivery of concrete	**0.3**	refer to : APA IS_Materials_Calculator_Version 1-2 2018-10-26 (locked)

											Construction Vehicles		
											Diesel Oil		
Project	Construction Phase	Personnel Description	# of Units	Equipment	Days	Fuel Consumtion	Total Fuel Consumption	Hours of Operation	Works Description	Fuel Energy	S1	S2	S3
						L/day	L	hrs		GJ	tCO_2-e		
	Watercourse Open Cut Crossings	Leading Hand	1	ute 4x4	110	35	3850	935					
		Operator	1	Hitachi 35T Exc	110	225	24750	935					
		Operator	1	Cat 572 Sideboom	110	125	13750	935	Operating Weight 31T/ Lifting capacity 40T				
		Operator	1	Cat 30T Moxy	110	200	22000	935	Operating Weight 28T/Capacity 15cu.m				
		Labour	1	ute 4x4	110	35	3850	935					
		Welder	1	Welding Truck	110	75	8250	935					
	Road Crossings Installation	Foreman	1	ute 4x4	110	35	3850	935					
		Leading Hand	1	ute 4x4	110	35	3850	935					
		Operator	1	Hitachi 35T Exc	110	225	24750	935					
		Operator	1	Cat 572 Sideboom	110	125	13750	935	Operating Weight 31T/ Lifting capacity 40T				
		Labour	1	ute 4x4	110	35	3850	935					
		Welder	2	Welding Truck	110	75	16500	1870					
	Watercourse Bore	Operator	1	Medium HDD	69	300	20700	586.5	American Augers DD110/DD220; 200 to 600 metres				
		Operator	1	Large HDD	69	500	34500	586.5	American Augers DD 440; Capacity of rigs dependent on ground conditions				
		Foreman	1	ute 4x4	69	35	2415	586.5					
		Technician	2	Guidance system	69	-	-	1173	Mud System (Assumed to be included in water course genset)				
		Operator	4	30T Exc	69	225	62100	2346	Cleaning System Shakers				
		Fitter	3	ute 4x4	69	35	7245	1759.5	Tanks/Vacuum Truck				
		Operator	1	Vac truck	69	100	6900	586.5					
		Equipment	1	Generator System	69	500	-	-	Included in stationary energy				
		Equipment	1	Mud System	69	450	31050	586.5					
	Major HDD	Operator	2	Large HDD	87	500	87000	1479	American Augers DD 440; Capacity of rigs dependent on ground conditions				
		Foreman	2	ute 4x4	87	35	6090	1479					
		Operator	4	30T Exc	87	225	78300	2958	Cleaning System Shakers; Large HDD operating 24Hrs				
		Fitter	1	ute 4x4	87	35	3045	739.5	Tanks/Vacuum Truck				
		Operator	1	Vac truck	87	100	8700	739.5	Equipment for pull back supplied by main contractor				
		Equipment	1	Generator System	87	500	-	-	included in stationary energy				
		Equipment	1	Mud System	87	650	56550	739.5					
	Fence Reinstatement	Foreman	1	ute 4x4	55	35	1925	467.5					
		Leading Hand	1	ute 4x4	55	35	1925	467.5					
		Operator	1	Tractor Post Driver	55	40	2200	467.5					
		Operator	1	10T truck	55	75	4125	467.5					
		Labour	3	ute 4x4	55	35	5775	1402.5					
	Reinstatement	Foreman	1	ute 4x4	55	35	1925	467.5					
		Leading hand	1	ute 4x4	55	35	1925	467.5					
		Operator	2	Hitachi 30t Exc	55	225	24750	935					
		Operator	1	Cat 16M Grader	55	300	16500	467.5	Operating Weight 32T				
		Operator	1	Cat 14M Grader	55	225	12375	467.5	Operating Weight 25T				
		Labour	2	ute 4x4	55	35	3850	935					
		Operator	1	Cat 30T Moxy	55	200	11000	467.5	Operating Weight 28T/Capacity 15cu.m				
	Hydrostatic Testing	NATA Engineer	1	ute 4x4	55	35	1925	467.5	NATA Certification required to sign off on test; Onsite usually for Strength/Leak Test only				
		Test Engineer	1	ute 4x4	110	35	3850	935	Testing usually run on 12hr shifts				
		L/H	1	ute 4x4	110	35	3850	935	1/shift; 1000ltrs/3.66 metres pipe length DN 600 pipe				
		Fitter	1	ute 4x4	110	35	3850	935	16 Megalitres required reuse water to reduce quantity				
		Labour	1	ute 4x4	110	35	3850	935	day/night shift 4/shift				
		Operator	1	Hiab truck/including compressor	110	350	38500	935	(900 cfm / 1200 cfm)				
Pakenham Delivery Facility	Site Establishment	Operator	1	Mulcher	5	50	250	42.5					
		Operator	2	12 Ton Tipper	3	75	225	51					
		Operator	2	Skid Truck	5	20	200	85	20% use - floated in				
		Operator	1	30T Exc	10	225	2250	85					
		Operator	1	Roller	10	75	750	85	compact crushed rock (assumed same fuel consumption as Compactor)				
		Labour	4	ute 4x4	5	35	700	170					
		Operator	5	Tilt Truck	1	150	750	42.5	drop off crib huts and containers (assume same fuel consumption as 10T Tipper				
		Equipment	2	Generator System	500	-	-	-	Included in Sta En: crib hut utilities - whole of constrcution life				
		Equipment	1	Fuel Cell	500	-	-	-	Assumed to be covere by genset (crib hut utilities - whole of constrcution life)				
		Equipment	1	Water Tank	500	-	-	-	Assumed coevred by genset : crib hut utilities - whole of constrcution life				
		Operator	2	Semi Trailer	2	100	400	34	delivery of temp fencing and concrete barriers				
		Labour	2	ute 4x4	5	35	350	85	misc. deliveries and site personnel				
	Tree Clearing and Grading	Operator	2	Harvester	14	100	2800	238	fell main tree trunks (assumed same fuel consumption as Lader 930)				
		Operator	2	Forestry tiller	14	75	2100	238	remove stumps and shrubbery (Assumed same fuel consumption as back hoe)				
		Operator	2	forwarder 8T / timber crane & t	14	75	2100	238	transport logs to stockpile and load into mulcher/onto truck (Assumed same fuel consumption as back hoe)				
		Operator	1	wood chipper	14	50	700	119	assummed same fuel consumption as mulcher				
		Operator	2	Excavator 30T	14	225	6300	238					
		Operator	3	Tip trucks and trailer	14	150	6300	357	Assuming option 1: remove trees in form of Mulch (assumed same fuel consumption as 10T tipper)				
		Operator	1	bulldozer	14	200	2800	119	clear rubble and grade (assumed same fuel consumption as Cat D6 Dozer)				
		Labour	27	ute 4x4	14	35	-	3213	Assumed included in the travel to / from site : personnel vehicles				
	Bulk Earthwoks	Operator	1	Water Truck	30	150	4500	255	15,000ltr water cart - suppress dust				
		Operator	2	30T Exc	30	225	13500	510	cut and fill				
		Operator	8	Tip trucks and trailer	30	150	36000	2040	cart away spoil (assumed same fuel sonsumption as 10T Tipper)				
		Operator	5	Tip trucks and trailer	30	150	22500	1275	bring in engineered fill (assumed same fuel sonsumption as 10T Tipper)				
		Operator	1	Roller	30	75	2250	255	compact crushed rock (assumed same fuel consumption as Compactor)				
		Operator	2	Compactor	30	75	4500	510	finish levelling				
		Labour	27	ute 4x4	30	35	-	6885	Assumed included in the travel to / from site : personnel vehicles				
	Piling	Operator	1	Semi Trailer	6	100	600	51	deliver piles/piers				
		Operator	1	Piling Rig	18	150	2700	153	drive piles into ground (Assummes same as Cat593 sideboom)				
		Operator	1	Skid Truck	18	100	1800	153					
		Operator	1	Sucker Truck	18	100	1800	153	NDD and pile spoil removal (assumed same fuel consumption as Vac Truck)				
		Operator	1	Fuel Trailer	18	100	1800	153	Assumed same fuel consumption as Semi				
		Operator	1	Welding Truck	18	75	1350	153					
		Labour	27	ute 4x4	18	35	-	4131	Assumed included in the travel to / from site : personnel vehicles				
	Civil foundations & retaining wall	Operator	6	Semi Trailer	24	100	14400	1224	deliver reo				
		Equipment	1	Angle grinder	24	-	-	204	Assumed to run off genset				
		Operator	2	Skid Truck	36	100	7200	612	general movement of site materials and loading/unloading of deliveries				
		Operator	1	Circular Saw	36	-	-	306	carpentry/cut formwork (assumed to run off genset				
		Operator	6	Concrete Truck	18	100	10800	918	deliver concrete (assumed same fuel consumption as semi)				
		Operator	1	Crane	6	125	750	51	lift formwork for retaining wall				
		Labour	27	ute 4x4	24	35	-	5508	Assumed included in the travel to / from site : personnel vehicles				
	SMPEI	Operator	10	Semi Trailer	120	100	120000	10200	Delivery of SMPEI materials to be installed				
		Operator	2	20T franna crane	120	22	5280	2040	lift heavy equipment/pre-fab buildings onto concrete foundations for install				
		Operator	2	Skid Truck	120	100	24000	2040	general movement of site materials and loading/unloading of deliveries				
		Equipment	1	Drill	120	-	-	1020	drill holes for chemical anchor studbolts (Assumed to run of genset				
		Equipment	6	Generator System	120	-	-	6120	to power tools (included in Stationary energy				
		Operator	1	Welding Truck	120	75	9000	1020	installation tools				
		Labour	1	bus	120	-	-	1020	Labour Transportation included in travel to and from site				
		Labour	35	ute 4x4	120	35		35700	Assumed included in the travel to / from site : personnel vehicles				
		Operator	1	Grader	18	300	5400	153	grading and sloping (assumed same fuel consumption as 16M Grader)				
		Operator	4	Concrete Truck	18	100	7200	612	deliver concrete for kerbing (assumed same fuel consumption as Semi				
		Operator	1	Kerbing Machine	18	30	540	153	form kerbs from concrete (assumed same fuel consumption as bending machine)				

APA Pipeline Works

Transport Fuel Emissions - Construction

Delivery of Materials	GHG	Reference
-	tCO_2-e	
Delivery of steel	**1151.6**	refer to : APA IS_Materials_Calculator_Version 1-2 2018-10-26 (locked)
Delivery of concrete	**0.3**	refer to : APA IS_Materials_Calculator_Version 1-2 2018-10-26 (locked)

											Construction Vehicles		
											Diesel Oil		
Project	Construction Phase	Personnel Description	# of Units	Equipment	Days	Fuel Consumtion	Total Fuel Consumption	Hours of Operation	Works Description	Fuel Energy	S1	S2	S3
						L/day	L	hrs		GJ	tCO_2-e		
	Roads	Operator	8	Tilt Truck	18	150	21600	1224	delivery of layers (Assumed same fuel consumption as 10T Tipper)				
		Operator	1	Roller	18	75	1350	153	prepare/compact sub base (assumed same fuel consumption as Compactor)				
		Operator	1	Semi Trailer	18	100	1800	153	proof roll				
		Operator	1	Roller	18	75	1350	153	install mid layer & top layer (asphalt) (assumed same fuel consumption as Compactor)				
		Labour	15	ute 4x4	18	35	-	2295	Assumed included in the travel to / from site : personnel vehicles				
	Commissionig	Labour	6	ute 4x4	48	35	-	2448	Assumed included in travel to / from sitepersonnel vehicles transport to and from site for commissioning works				

APA Pipeline Works

Transport Fuel Emissions - Construction

Delivery of Materials	GHG	Reference
-	tCO_2-e	
Delivery of steel	**1151.6**	refer to : APA IS_Materials_Calculator_Versio
Delivery of concrete	**0.3**	refer to : APA IS_Materials_Calculator_Versio

											Staff Commute		
											Diesel Oil		
Project	Construction Phase	Personnel Description	# of Units	Equipment	Days	Average Daily Travel Distance	Total km travelled	Average Vehicle Fuel Consumption	Fuel consumption	Fuel Energy	S1	S2	S3
						km		L/100km	L	GJ	tCO_2-e		
						60	**1,667,760**	**10.8**	**180,118**	**6,953**	-	-	**490.22**
	Project Management	Project Manager	1	4x4 wagon	176		10560						
		Construction Manager	1	4x4 wagon	176		10560						
		Superintendent	1	4x4 wagon	176		10560						
		Engineering Manager	1	ute 4x4	176		10560						
		Site Engineer	3	ute 4x4	176		31680						
		Safety Manager	1	4x4 wagon	176		10560						
		Safety Officer	1	ute 4x4	176		10560						
		Environmental Manager	1	ute 4x4	176		10560						
		Environmental Officer	2	ute 4x4	176		21120						
		QA Manager	1	4x4 wagon	176		10560						
		QA Inspector	8	ute 4x4	176		84480						
		Landowner Liasion	1	ute 4x4	176		10560						
		Commercial Manager	1		176		0						
		Contracts Officer	1		176		0						
		Administration	2		176		0						
	Fencing	Labour	3	ute 4x4	55		9900						
		Operator	1	Tractor Post Driver	55		3300						
		Operator	2	10T truck	55		6600						
	Access and ROW Maintenance	Foreman	1	ute 4x4	55		3300						
		Operator	1	140G Grader	55		3300						
		Operator	1	Backhoe	55		3300						
		Operator	1	Compactor	55		3300						
		Operator	1	water cart	55		3300						
		Labour	1	ute 4x4	55		3300						
	Tree Clearing	Foreman	1	ute 4x4	20		1200						
		Leading hand	1	ute 4x4	20		1200						
		Operator	1	24T Excavator	20		1200						
		Operator	1	Hiab	20		1200						
		Fauna Handler	1	ute 4x4	20		1200						
		Operator	1	Mulcher	20		1200						
	Environmental Controls	Foreman	1	ute 4x4	110		6600						
		Operator	1	Backhoe	110		6600						
		Operator	1	140G Grader	110		6600						
		Labour	1	Crew cab truck	110		6600						
	Clear & Grade	Foreman	1	ute 4x4	69		4140						
		Leading hand	1	ute 4x4	69		4140						
		Operator	1	Hitachi 30t Exc	69		4140						
		Operator	1	Cat 16M Grader	69		4140						
		Operator	1	Cat 14M Grader	69		4,140						
		Operator	1	Cat D6 Dozer	69		4140						
		Labour	1	ute 4x4	69		4140						
		Operator	1	Cat 30T Moxy	69		4140						
	Pipe Yard	Foreman	1	ute 4x4	69		4140						
		Operator	1	Hitachi 30t Exc	69		4140						
		Operator	6	Ext trailer	69		24840						
	Strining and Bending	Stringing Foreman	1	ute 4x4	69		4140						
		Operator	1	Hitachi 30T Exc	69		4140						
		Operator	1	Skid Truck	138		8280						
		Operator	1	Skid Truck	138		8280						
		Leading Hand	1	ute 4x4	69		4140						
		Bending Engineer	1	ute 4x4	69		4140						
		Operator	1	CRC Bending Machine	69		4140						
		Operator	1	Cat 572 Sideboom	69		4140						
		Labour	2	ute 4x4	69		8280						
		Operator	1	15,000ltr water cart	69		4140						
	Mainline Welding	Operator	1	Cat 561 Sideboom	55		3300						
		Operator	1	Tac Rig	55		3300						
		Operator	2	10T Truck	55		6600						
		Welder	2	Welding Truck	55		6600						
		Operator	1	15,000ltr water cart	55		3300						
	Non-destructive testing	NDT supervisor	1	ute 4x4	55		3300						
		Technician	1	ute 4x4	55		3300						
		Technician	1	ute 4x4	55		3300						
		Technician	1	ute 4x4	125		7500						
	Coating	Foreman	1	ute 4x4	55		3300						
		Leading Hand	1	ute 4x4	55		3300						
		Operator	1	Blast truck/including compressor	55		3300						
		Operator	1	Spray truck	55		3300						
		Labour	1	ute 4x4	55		3300						
		Coater	1	Hiab truck/including compressor	55		3300						
		Operator	1	15,000ltr water cart	55		3300						
	Trenching	Foreman	1	ute 4x4	55		3300						
		Leading Hand	1	ute 4x4	55		3300						
		Operator	2	Hitachi 35T Exc	55		6600						
		Operator	1	Bucket Wheel Trencher 780	55		3300						
		Operator	1	Bucket Wheel Trencher 1075	55		3300						
		Operator	1	Chain Trencher	55		3300						
		Labour	2	ute 4x4	55		6600						
		Boilermaker	1	Hiab truck	55		3300						
	Lower In	Foreman	1	ute 4x4	55		3300						
		Leading Hand	1	ute 4x4	55		3300						
		Operator	1	Cat 572 Sideboom	55		3300						
Pipeline+MLV		Operator	2	Hitachi 35T Exc	55		6600						
		Operator	1	Superior 250 Padder	55		3300						
		Operator	1	Superior 350 Padder	55		3300						
		Operator	2	Cat 572 sideboom	55		6600						
		Operator	1	Cat 583 sideboom	55		3300						
		Operator	1	15,000ltr water cart	55		3300						
	Backfill	Foreman	1	ute 4x4	55		3300						
		Leading Hand	1	ute 4x4	55		3300						
		Operator	1	Cat D6 dozer	55		3300						
		Operator	1	Cat 16M Grader	55		3300						
		Operator	1	Cat 14M Grader	55		3300						
		Operator	1	Cat 930 Loader	55		3300						
		Operator	1	Hitachi 35T Exc	55		3300						
		Labour	2	ute 4x4	55		6600						
	Specials RVX, RDX and Tie Ins (Lower In)	Foreman	1	ute 4x4	110		6600						
		Leading Hand	1	ute 4x4	110		6600						
		Operator	3	Hitachi 35T Exc	110		19800						
		Operator	3	Cat 572 sideboom	110		19800						
		Labour	2	ute 4x4	110		13200						
		Operator	1	Cat 30T Moxy	110		6600						
		Welder	2	Welding Truck	110		13200						
	Street Works Hastings	Foreman	2	ute 4x4	74		8880						
		Leading Hand	2	ute 4x4	74		8880						
		Operator	1	Hitachi 30T Exc	74		4440						
		Labour	2	ute 4x4	74		8880						
		Operator	1	12 Ton Tipper	74		4440						
		Labour	1	Hiab Truck	74		4440						
		Welder	1	Welding Rig	74		4440						
		Operator	1	Street Sweeper	74		4440						
	Rail Bore	Equipment	1	Auger Bore	27		0						
		Foreman	1	ute 4x4	27		1620						
		Operator	1	Hiab Truck	27		1620						
		Operator	1	30T Exc	27		1620						
	Road Bore	Operator	1	Mini HDD	69		4140						
		Operator	1	Semi Trailer	69		4140						
		Foreman	1	ute 4x4	69		4140						
		Operator	1	30T Exc	69		4140						
		Foreman	1	ute 4x4	110		6600						

APA Pipeline Works

Transport Fuel Emissions - Construction

Delivery of Materials	GHG	Reference
-	tCO_2-e	
Delivery of steel	**1151.6**	refer to : APA IS_Materials_Calculator_Versio
Delivery of concrete	**0.3**	refer to : APA IS_Materials_Calculator_Versio

											Staff Commute		
											Diesel Oil		
Project	Construction Phase	Personnel Description	# of Units	Equipment	Days	Average Daily Travel Distance	Total km travelled	Average Vehicle Fuel Consumption	Fuel consumption	Fuel Energy	S1	S2	S3
						km		L/100km	L	GJ	tCO_2-e		
	Watercourse Open Cut Crossings	Leading Hand	1	ute 4x4	110		6600						
		Operator	1	Hitachi 35T Exc	110		6600						
		Operator	1	Cat 572 Sideboom	110		6600						
		Operator	1	Cat 30T Moxy	110		6600						
		Labour	1	ute 4x4	110		6600						
		Welder	1	Welding Truck	110		6600						
	Road Crossings Installation	Foreman	1	ute 4x4	110		6600						
		Leading Hand	1	ute 4x4	110		6600						
		Operator	1	Hitachi 35T Exc	110		6600						
		Operator	1	Cat 572 Sideboom	110		6600						
		Labour	1	ute 4x4	110		6600						
		Welder	2	Welding Truck	110		13200						
	Watercourse Bore	Operator	1	Medium HDD	69		4140						
		Operator	1	Large HDD	69		4140						
		Foreman	1	ute 4x4	69		4140						
		Technician	2	Guidance system	69		8280						
		Operator	4	30T Exc	69		16560						
		Fitter	3	ute 4x4	69		12420						
		Operator	1	Vac truck	69		4140						
		Equipment	1	Generator System	69		-						
		Equipment	1	Mud System	69		-						
	Major HDD	Operator	2	Large HDD	87		10440						
		Foreman	2	ute 4x4	87		10440						
		Operator	4	30T Exc	87		20880						
		Fitter	1	ute 4x4	87		5220						
		Operator	1	Vac truck	87		5220						
		Equipment	1	Generator System	87		-						
		Equipment	1	Mud System	87		-						
	Fence Reinstatement	Foreman	1	ute 4x4	55		3300						
		Leading Hand	1	ute 4x4	55		3300						
		Operator	1	Tractor Post Driver	55		3300						
		Operator	1	10T truck	55		3300						
		Labour	3	ute 4x4	55		9900						
	Reinstatement	Foreman	1	ute 4x4	55		3300						
		Leading hand	1	ute 4x4	55		3300						
		Operator	2	Hitachi 30t Exc	55		6600						
		Operator	1	Cat 16M Grader	55		3300						
		Operator	1	Cat 14M Grader	55		3300						
		Labour	2	ute 4x4	55		6600						
		Operator	1	Cat 30T Moxy	55		3300						
	Hydrostatic Testing	NATA Engineer	1	ute 4x4	55		3300						
		Test Engineer	1	ute 4x4	110		6600						
		L/H	1	ute 4x4	110		6600						
		Fitter	1	ute 4x4	110		6600						
		Labour	1	ute 4x4	110		6600						
		Operator	1	Hiab truck/including compressor	110		6600						
	Site Establishment	Operator	1	Mulcher	5		300						
		Operator	2	12 Ton Tipper	3		360						
		Operator	2	Skid Truck	5		600						
		Operator	1	30T Exc	10		600						
		Operator	1	Roller	10		600						
		Labour	4	ute 4x4	5		1200						
		Operator	5	Tilt Truck	1		300						
		Equipment	2	Generator System	500		-						
		Equipment	1	Fuel Cell	500		-						
		Equipment	1	Water Tank	500		-						
		Operator	2	Semi Trailer	2		240						
		Labour	2	ute 4x4	5		600						
	Tree Clearing and Grading	Operator	2	Harvester	14		1680						
		Operator	2	Forestry tiller	14		1680						
		Operator	2	forwarder 8T / timber crane & t	14		1680						
		Operator	1	wood chipper	14		840						
		Operator	2	Excavator 30T	14		1680						
		Operator	3	Tip trucks and trailer	14		2520						
		Operator	1	bulldozer	14		840						
		Labour	27	ute 4x4	14		22680						
	Bulk Earthwoks	Operator	1	Water Truck	30		1800						
		Operator	2	30T Exc	30		3600						
		Operator	8	Tip trucks and trailer	30		14400						
		Operator	5	Tip trucks and trailer	30		9000						
		Operator	1	Roller	30		1800						
		Operator	2	Compactor	30		3600						
		Labour	27	ute 4x4	30		48600						
Pakenham Delivery Facility	Piling	Operator	1	Semi Trailer	6		360						
		Operator	1	Piling Rig	18		1080						
		Operator	1	Skid Truck	18		1080						
		Operator	1	Sucker Truck	18		1080						
		Operator	1	Fuel Trailer	18		1080						
		Operator	1	Welding Truck	18		1080						
		Labour	27	ute 4x4	18		29160						
	Civil foundations & retaining wall	Operator	6	Semi Trailer	24		8640						
		Equipment	1	Angle grinder	24		-						
		Operator	2	Skid Truck	36		4320						
		Operator	1	Circular Saw	36		2160						
		Operator	6	Concrete Truck	18		6480						
		Operator	1	Crane	6		360						
		Labour	27	ute 4x4	24		38880						
	SMPEI	Operator	10	Semi Trailer	120		72000						
		Operator	2	20T franna crane	120		14400						
		Operator	2	Skid Truck	120		14400						
		Equipment	1	Drill	120		0						
		Equipment	6	Generator System	120		0						
		Operator	1	Welding Truck	120		7200						
		Labour	1	bus	120		7200						
		Labour	35	ute 4x4	120		252000						
		Operator	1	Grader	18		1080						
		Operator	4	Concrete Truck	18		4320						
		Operator	1	Kerbing Machine	18		1080						

APA Pipeline Works

Transport Fuel Emissions - Construction

Delivery of Materials	GHG	Reference
-	tCO_2-e	
Delivery of steel	**1151.6**	refer to : APA IS_Materials_Calculator_Versio
Delivery of concrete	**0.3**	refer to : APA IS_Materials_Calculator_Versio

											Staff Commute		
											Diesel Oil		
Project	Construction Phase	Personnel Description	# of Units	Equipment	Days	Average Daily Travel Distance	Total km travelled	Average Vehicle Fuel Consumption	Fuel consumption	Fuel Energy	S1	S2	S3
						km		L/100km	L	GJ	tCO_2-e		
	Roads	Operator	8	Tilt Truck	18		8640						
		Operator	1	Roller	18		1080						
		Operator	1	Semi Trailer	18		1080						
		Operator	1	Roller	18		1080						
		Labour	15	ute 4x4	18		16200						
	Commissionig	Labour	6	ute 4x4	48		17280						

APA Pipeline Works

Embodied Emissions - Construction

										APA Pipeline Embodied Emissions		
										Embodied Emissions		
Component	Material	Outside Diameter	Wall thickness	Inside Diameter	Cross-section	Length	Volume	Density of Carbon Steel	Total Mass	S1	S2	S3
		m	m	m	m^2	m	m^3	kg/m^3	Tonnes	tCO_2-e		
Pipeline	DN600 XS Carbon Steel Pipe	0.61	0.0127	0.585	0.0238	57200	1363.145258	7850	10,700.69	-	-	24,481
Component	Material	%SCM	Strength Grade	Amount	Transport Distance	Source				S1	S2	S3
		%	Mpa	m3	km	-				tCO2-e		
Concrete	Ready Mix - Facilities and MLVs	0	50	20	55	IS Calculator				-	-	12
	Ready Mix - MLV1 Denham Road Hastings	0	32	21.25	2.2	IS Calculator				-	-	8
	Ready Mix - MLV1 Denham Road Hastings	0	25	1.85	2.2	IS Calculator				-	-	1
	Ready Mix - MLV2 Bloomfield Lane Cardinia	0	32	18.27	14.3	IS Calculator				-	-	3
	Ready Mix - MLV2 Bloomfield Lane Cardinia	0	25	1.85	14.3	IS Calculator				-	-	1
	Pre-cast - Protection Slabs	0	40	375	6	IS Calculator				-	-	212

Source: APA_IS_Materials_Calculator_Version 1-2 2018-10-26 (locked)

APA Pipeline Works

Carbon sinks - Construction

					Carbon Sinks		
Ecological Vegetation Class	Area to be cleared	Vegetation Class	Biomass Max Class	Carbon Value	S1	S2	S3
	ha			tCO_2-e/ha	tCO_2-e		
Damp sands herb-rich woodlands	0.04	I	4	110	4		
Heathy woodland	4.26	H	2	309	1,316		
Swamp scrub	3.97	I	4	110	437		
Swampy riparian woodland	0.61	D	3	307	186		
Grassy woodland	1.24	D	3	307	381		
Damp heathy woodland	1.36	H	2	309	420		
Tall marsh	0.28	I	4	110	31		
Swampy woodland	0.06	D	3	307	19		
Estuarine Scrub	0.25	I	4	110	28		
Aquatic herbland	0.11	-	4	521	55		
Coastal saltmarsh	0.13	-	4	521	70		
Additional scattered trees	3.05	-	2	309	943		
Total	**15.353**				**3,887**	**0**	**0**

APA Pipeline Works

GHG Emissions Calculations - Operations Summary

Date 15/01/2020
Revision R05
Completed By DM
Checked By AK, JH

Emissions Source	Project Activity	Total Annual Emissions		
		Scope 1	Scope 2	Scope 3
Stationary fuel	Natural gas consumed by the Pakenham water bath heaters	8,734.1	-	661.0
Transport fuel	Fuel consumed by APA piepline survey vehicles	0.4	-	0.0
Transport fuel	Fuel consumed by general staff movements	1.4	-	0.1
Purchased electricity	Electricity consumed at the Pakenham delivery facility	-	324	31.7
Purchased electricity	Electricity consumed at the Pakenham water bath heaters	-	594.9	58.3
Fugitive Emissions	Fugitive emissions from the Pakenham delivery facility	28.7	-	-
Fugitive Emissions	Fugitive emissions from the Crib Point Pakenham transmission pipeline	15.2	-	-
Total Emissions		**8,780**	**918.5**	**751**

APA Pipeline Works

Stationary Fuel Emissions - Operations

	Pakenham Water Bath Heaters		
	Grid Electricity		
	S1	S2	S3
	tCO_2-e/annum		
	3,319	-	251
	3,398	-	257
	2,017	-	153
Total	**8,734**	**-**	**661**

Activity Data														
Operation					Pakenham Water Bath Heaters WINTER				Pakenham Water Bath Heaters SUMMER				TOTAL	
Total Cargoes @ send out rate	Lean	Rich	Operational Days	Operational Hours	Lean Gas Demand	Lean Gas Operation	Rich Gas Demand	Rich Gas Operation	Lean Gas Demand	Lean Gas Operation	Rich Gas Demand	Rich Gas Operation	Total Fuel Gas Consumption	Fuel Gas Consumption
#	#	#	days/annum	hrs/day	MW	days/annum	MW	days/annum	MW	days/annum	MW	days/annum	MWh/annum	GJ/annum
20	20	-	213	24	6.7	0	9.5	0	3.5	213	5.8	0	17,892	64,411
16	11	5	122	24	9.10	83.88	13.00	0	5.10	-	8.20	38.13	18,318.30	65,946
4	3	1	30	24	13.70	22.50	19.30	7.50	8.10	-	12.60	-	10,872	39,139
												Total		**169,496**

APA Pipeline Works

Purchased Electricity Emissions - Operations

		Pakenham Delivery Facility			Pakenham Water Bath Heaters		
		Grid Electricity			Grid Electricity		
	Operation	S1	S2	S3	S1	S2	S3
		tCO_2-e/annum			tCO_2-e/annum		
		-	189	19	n/a	n/a	n/a
		-	108	11	-	524	51
		-	27	3	-	71	7
Total		**-**	**324**	**32**	-	**595**	**58**

Activity Data											
Operation					Pakenham Facility			Pakenham Water Bath Heaters			
Total Cargoes @ send out	Lean	Rich	Operational Days	Operational Hours	Plant & Control Building	Hours of Operation	Electrical Energy Demand	Water Bath Heaters	Demand levels	Operational days	Total energy demand
#	#	#	days/annum	hrs/day	kW	hrs/annum	kWh/annum	kW	%	days/annum	kWh/annum
20	20	-	213	24	36.217	5,112	185,141	96.77			
16	11	5	122	24	36.217	2,928	106,043	96.77	66.0%	335.00	513,522
4	3	1	30	24	36.217	720	26,076	96.77	100.0%	30.00	69,677

APA Pipeline Works

Transport Fuel Emissions - Operations

APA Survey Vehicles			General Staff Movements		
Diesel			Diesel		
S1	S2	S3	S1	S2	S3
tCO_2-e			tCO_2-e		
0.40	-	0.02	1.41	-	0.07

Activity Data													
APA Survey Vehicles							General Staff Movements						
Survey return distance	Frequency	Total Distance	Fuel Economy	Fuel Consumption	Fuel Energy	Total Fuel Energy	Return distance	Frequency	Total Distance	Fuel Economy	Fuel Consumption	Fuel Energy	Total Fuel Energy
km/trip	trips/year	km/year	L/100km	L/year	GJ/kL	GJ/year	km/trip	trips/year	km/year	L/100km	L	GJ/kL	GJ
114.4	12	1,373	10.8	148.26	39	5.72	92.4	52	4,805	10.8	518.92	39	20.03

APA Crib Point Pakenham Pipeline Project

Fugitive Emissions - Operations

Pakenham Metering Plant			Pipeline Transmission		
Fugitive			Fugitive		
S1	S2	S3	S1	S2	S3
tCO_2-e			tCO_2-e		
29			15		

Pakenham Metering Plant			Pipeline Transmission			
Number of Plants					Pipeline Length	Operational Hours
#					km	hrs
1.00					57.20	8,760.00

APA Pipeline Works
GHG Emissions Factors

National Greenhouse Account Factors - August 2019
Australian Government - Department of the Environment and Energy

2.1 Stationary Energy emissions (non-transport)
2.1.2 Fuel combustion emissions - gaseous fuels

Fuel combusted	Energy content factor GJ/m3	Emission factor (kg CO_2.e/GJ)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Natural gas distributed in a pipeline	0.0393	51.40	0.10	0.03	51.53	0.00	3.90
Liquefied natural gas	25.3 GJ/kL	51.40	0.10	0.03	51.53	0.00	0.00

2.1.3 Fuel combustion emissions - liquid fuels

Fuel combusted	Energy content factor GJ/kL	Emission factor (kg CO_2-e/GJ)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Diesel oil	38.60	69.90	0.10	0.20	70.20	0.00	3.60
Petroleum based products other than me	34.40	69.80	0.00	0.20	70.00	0.00	3.60

2.2 Transport fuel emissions (post-2004)

Fuel combusted	Energy content factor GJ/kL	Emission factor (kg CO_2.e/GJ)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Gasoline (other than for use as fuel in ar	34.20	67.40	0.02	0.20	67.62	0.00	3.60
Diesel oil	38.60	69.90	0.01	0.60	70.51	0.00	3.60
Liquefied petroleum gas	26.20	60.20	0.40	0.30	60.90	0.00	3.60
Fuel Oil	39.70	73.60	0.07	0.60	74.27	0.00	3.60

2.3 Indirect emissions from electricity

State or Territory		Emission factor (kg CO_2.e/kWh)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Victoria					0.00	1.02	0.10

2.4.2.7 Natural gas transmission
Transmission mains are defined as high-pressure pipelines greater than 1050 kilopascals, as used in the Energy Supply Association of Australia natural gas statistics.

Operation or process source		Emission factor (tonnes CO_2-e/km pipeline length)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Natural gas transmission tCO2e/km pipe		0.02	10.40	0.00	10.42	0.00	0.00
Gas flared tCO2e/t flared		2.70	0.10	0.03	2.83	0.00	0.00

3.19 Industrial processes - emissions of hydroflurocarbons and sulphur hexaflouride gases

Equipment type	Default HFCs annual leakage rates of gas			
Commercial air conditioning—chillers	0.09			
Commercial refrigeration - supermarket systems	0.23			
Industrial refrigeration including food processing and cold storage	0.16			

Appendix 4 - Emissions from waste disposal to landfill and wastewater treatment

Operation or process source		Emission factor (t CO_2-e/t waste)					
		CO_2	CH_4	N_2O	Scope 1	Scope 2	Scope 3
Municipal solid waste							1.4
Commercial and industrial waste							1.2
Construction and demolition waste							0.2

API Compendiminium

Table 6-6. Fugitive emissions factors for natural gas transmission and storage equipment (American Petroleum Institute (API), Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry, p 6-17)

Equipment basis	Units	Emission factor					
		CO_2	CH_4	N_2O	Scope 1 (CO_2-e)	Scope 2	Scope 3
Compressor stations	t/station-hr		0.0070200		0.1755000		
Storage Stations	t/station-hr		0.0172000		0.4300000		
Metering/regulation stations	t/station-hr		0.0001310		0.0032750		
Metering/regulation stations transmissior	t/station-hr		0.0031800		0.0795000		
Gas transmission pipeline	**t/km-hr**	**0.0000003**	**0.0000012**		**0.0000303**		
CO2 from oxidation	t/km-hr	0.0000002			0.0000002		
CO2 from leaks	t/km-hr	0.0000000			0.0000000		

LNG Operations Consistent Methodology for Estimating Greenhouse Gas Emissions (Source: International Maritime Organization (IMO), 2009, Second IMA GHG Study 2009: Table 9.1 page 131)

Operation or process source	Units	Emission factor					
		CO_2	CH_4	N_2O	Scope 1 (CO_2-e)	Scope 2	Scope 3
Transport of LNG by tanker	kg/tonne-km travelled	14.5	0.02	0.1	0.0448		

Embodied Carbon in Materials - APA ISCA Materials Calculator (IS_Materials_Calculator_Version 1-2 2018-10-26)	
	tCO_2/tonne of material
Carbon Steel Pipe	2.2878315

Attachment 5

Total Scope 3 Emissions		
Fuel Gas		
S1	S2	S3
tCO2-e		
		1,307,200

Total LNG imported by AGL		Total LNG
PJ	GJ	tonnes
160	160,000,000	3,040,000

Conversion - LNG

GJ	**TONNE**
1	0.019
160,000,000	3,040,000

Source: https://www.platts.com/IM.Platts.Content/MethodologyReferences/ConversionTables/Images/NGSS1015_LNG_Industry_Conversions_LRG.pdf

Emissions inensity of LNG production

Qatargas 2018 Sustainability Report

GHG Intensity - relative to LNG production

0.43 Tonnes of CO_2-e/tonne of LNG produced