

# ÖkoRess III

## Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

**Escondida**

**BHP Billiton , Chile**

ID: 33

## Note

The qualitative assessment of Environmental Hazard Potentials (EHPs) in this factsheet was conducted according to the method developed in the precursor project ÖkoRess I “Discussion of the environmental limits of primary raw material extraction and development of a method for assessing the environmental availability of raw materials to further develop the criticality concept”<sup>1</sup> (Dehoust et al. 2017a). The measurement instructions applied here are described in Dehoust et al. 2017b. The method is tested and further developed within this project (ÖkoRess III).

The information in this factsheet refers exclusively to publicly available, designated sources that have been classified as serious by the authors. It is specifically pointed out that no statement is made about the implementation and quality of agreements or standards that are applied. The implementation of agreements through memberships, certifications, etc. is the responsibility of the companies.

The surface extension of each mine area has been estimated based on publically accessible satellite images as official land-use plans from the public authorities or mine operators are not consistently available. It therefore only corresponds to the apparent area where mining, processing facilities, heaps, etc. and related infrastructure are clearly identifiable.

The fact sheets make no claim to completeness of all relevant voluntary standards. Mentioning a membership in one of the listed voluntary standards does not imply an assessment of the suitability of the standard in itself, nor does it make any statement about the member's success in implementation.

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<sup>1</sup>TEXTE 87/2017 <https://www.umweltbundesamt.de/publikationen/discussion-of-the-environmental-limits-of-primary>

# Escondida

## Copper

General information 	
Indicator or criteria	Description and values
Name of mine	Escondida
Description of mining area	The mine is located in the arid northern Atacama. The mine is divided in two open-pit operations (5 km apart): Escondida and Escondida Norte.
Surface extension	291.85km <sup>2</sup> 291.85 km <sup>2</sup> (Image date: 31.03.2019; Viewing height: 34.10 km) (Google Earth)
In operation since	1990 1990
Operator	Minera Escondida
Owner	BHP Billiton
Closest town	170 km SE of Antofagasta (BHP 2018a)
Province	Región de Antofagasta
Country	Chile
Longitude	-69.070556°
Latitude	-24.269444°
Altitude	3050 m a.s.l. 3050 m a.s.l. (Mining Technology n.d.)
Main product and by-products	Main product: copper (sulphide/oxide); By-products: Silver, gold (Mining Technology n.d.).
On-site processing stages	The Escondida mine site has a highly integrated infrastructure. The mining takes place in two open-pit operations (Escondida and Escondida Norte). The sulphide and oxide ores are further processed at the site. The sulphide ore is crushed and then treated in concentrator with flotation. The oxide ore is crushed and then

	further treated with solvent extraction-electro winning technology in order to produce copper cathode (Rode 2015).
Annual production	FY2018: 1.213 Mt (copper, sulphide/oxide), FY2016: 0.978 Mt (copper, sulphide/oxide) (BHP 2018a). FY2018: 8,796 t ounces (silver), FY2016: 5,561 t ounces (silver) (BHP 2018a). FY2018: 229 t ounces (gold), FY2016: 109 t ounces (gold) (BHP 2018a).
Proven Reserves	5.133 Mt ore (Escondia and Escondida Norte) (BHP 2018a).
Probable Reserves	2,466 Mt ore (Escondia and Escondida Norte) (BHP 2018a).

## Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	At the site sulphide and oxide ore is mined. Sulphide ore accounts for the largest part of production (about 76 % in FY2018) (BHP 2018a).	Sulphide copper ore is according to Cissarz defined as chalkophile. A high potential for AMD is therefore given. The measurement instruction suggests a high EHP.	High	B2 = medium, classified according to measurement instructions
Paragenesis with heavy metals	Paragenesis of copper with other heavy metals such as lead, zinc, arsenic or nickel often occurs (Dehoust et al. 2017b). No first-hand information from the owner could be obtained. But studies on dust pollution in Antofagasta relate the high concentrations of As, Mo and Zn directly to Chilean Cu concentrates stored at the port. The deposit of La Escondida is especially highlighted for its Zn anomalies (Tapia et al. 2018).	Since copper itself is considered to be a harmful metal to the ecosystem and human health, the measure guidance suggests a high EHP.	High	B2 = medium, classified according to measurement instructions

Paragenesis with radioactive components	No indication of paragenesis with thorium or uranium could be determined.	In accordance with the measurement instructions, copper ore deposits are evaluated with a medium EHP, if no other information is available.	Medium	B2 = medium, classified according to measurement instructions
Deposit size	The current reported reserve is 7,600 Mt ore (Escondia and Escondida Norte) (BHP 2018a). The mine has been producing since 1990. In its first year it produced 0.32 Mt of copper at an average ore grade of 2.9% (Darling 2011). Further production numbers and ore grades were obtained from annual reports between 2007 and 2018. Missing annual data in between were interpolated. Taking into account the ore grade, the cumulated extracted ore between 1990 and 2018 is 2,220 Mt. Together with the reported reserve of 7,600 Mt ore, the total size of the deposit is roughly estimated to be 9,820 Mt ore.	Considering the ore grade, the mine lies within the category of "gigantic mine" after the Petrow classification. The measurement instructions indicate a high EHP in this case.	High	A = high, can be derived directly from available data
Ore grade	0.41-0.66 (BHP 2018a).	The mine site has an average grade of 0.6%. According to the measurement instructions, copper deposits with an ore grade of 0.5-3% are categorized as medium, leading to an evaluation result of a medium EHP.	Medium	A = high, can be derived directly from available data

Technology 				
Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Open-Pit	The measure instructions ranks open-pit mining with medium EHP	Medium	A = high, can be derived directly from available data
Use of auxiliary substances	During the concentration process, the milled sulphide ore undergoes flotation and a binder is added to the slurry leading to the separation of the copper from the rock.	Flotation and the usage of chemical binders are usually toxic/not degradable. The measurement instructions suggests a high EHP in this case.	High	A = high, can be derived directly from available data
Mining waste	BHP seems to put great emphasis on water strategy but this is also due to water scarcity which threatens mining operation. A risk review was conducted of all significant dams across the operated assets and the assets in FY2016, which confirmed the dams to be stable (BHP 2018b). The tailing dams of Laguna Seca have an officially authorised maximum height of 107 m and capacity of 4,171 Mt m (Consejo Minero n.d.). Focus of BHP is on water strategy and security of dams (Risner et al. 2018). BHP put forward a plan for closure which includes waste management after active operation. In 2019 it is planned for final approval (BHP 2017). However, the plan is not publically available yet.	Since Escondida is a gigantic mine with huge tailings and information to the waste management for post closure are not yet publically available, a medium EHP is suggested by the measurement instructions.	Medium	B2 = medium, classified according to measurement instructions

<p>Remediation measures</p>	<p>Our standards also require us to minimise the potential of adverse environmental impacts following closure. Our closed sites are required to have closure management plans, with long-term monitoring to verify that controls are effective and performance standards are maintained“ (BHP 2018a). BHP claims to have developed a standard for closure for all its assets. But a specific plan for BHP put forward a plan for closure. In 2019 it is planned for final approval (BHP 2017). However, the plan is not publically available yet.</p>	<p>A closure plan for Escondida is developed. But taken into account the plans status of transition and its inaccessibility for public, a medium EHP is given.</p>	<p>Medium</p>	<p>C = low, no concrete information, no general specifications in the measurement instructions, (expert) estimate</p>
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## Framework conditions natural environment



Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
<p>Accident hazard due to floods, earthquake, storms, landslides</p>	<p>The rating system for the 4 sub-indicators uses georeferenced data from publicly available risk maps (see measurement instructions). Metrics are directly taken from the given risk assessment. The indicator total is determined by the highest hazard level of the sub-indicators.</p>	<p>The Environmental Hazard Potential (EHP) for earthquakes is high, else the EHP is negligible for floods, tropical storms, and the arctic environment.</p>	<p>High</p>	<p>B2 = medium, classified according to measurement instructions</p>
<p>Water Stress Index (WSI) und desert areas</p>	<p>The WSI by Pfister et al. (2009) provides characterization factors on the relative water availability at watershed level. Absolute water shortages in dry areas is</p>	<p>EHP for water stress is high and the mine is situated in a desert area</p>	<p>High</p>	<p>B2 = medium, classified according to</p>

	supplemented by desert areas. The highest hazard level of the sub-indicators determines the total result.			measurement instructions
Protected areas and AZE sites	Georeferenced data for designated protected areas are used to assess hazards posed by mining extraction. The metric to evaluate EHPs corresponds to the method first described in the draft standard of the Initiative for Responsible Mining Assurance (IRMA 2014).	There is a low EHP for protected areas and AZE sites.	Low	B2 = medium, classified according to measurement instructions

## State Governance

Indicators	
WGI 1 -Voice and Accountability	79.31 <sup>ooo</sup>
WGI 2 -Political Stability and Absence of Violence/ Terrorism	60.95 <sup>ooo</sup>
WGI 3 - Government Effectiveness	77.88 <sup>ooo</sup>
WGI 4 -Regulatory Quality	88.94 <sup>ooo</sup>
WGI 5 - Rule of Law	81.73 <sup>ooo</sup>
WGI 6 -Control of Corruption	82.21 <sup>ooo</sup>

EPI (Environmental Performance Index)	57.49
EITI membership	n.d.
<b>International Agreements</b>	
ILO 176	No
Others	Ratification of the Minamata Convention on Mercury 27.08.2018 (UNEP 2019) Signature of the Paris Agreement on Climate Change (which entered into force on 12.03.2017) (UNFCCC 2016).
<b>Legal framework</b>	

<p>Areas of Law: Environment</p>	<p>The Chilean state is obliged to guarantee a pollution-free environment through environmental legislation. The Environmental Law 19.300 includes the statutory environmental framework and defines that Environmental Impact Assessments (EIA) are mandatory to obtain an environmental license for projects in the mining sector. To these belong, e.g., projects for minerals, oil, gas and coal at different stages of the mine life cycle (exploration to mine closure), (EI SourceBook 2016).</p> <p>The design of the EIAs differ, depending on the potential hazards to a number of social or environmental circumstances. Previous consent of indigenous communities need to be obtained, if these communities are directly affected by a mining project (Minehutte 2019).</p> <p>Three main institutions -with different and defined roles- enforce the environmental regulations: The Ministry of Environment, the Environmental Assessment Service and the Environmental Superintendence. Moreover, according to Law No. 20.600, Environmental Courts have the power to resolve environmental disputes. EIS are presented to the responsible Regional Commission on the Environment or the Executive Directorate of the National Commission on the environment if several regions are affected (Minehutte 2019).</p>
<p>Areas of Law: Occupational Health and Safety (OHS)</p>	<p>Chile ratified the ILO Convention N° 161 Occupational Health Services Convention since 1999 (MDNP 2018). The Supreme Decree No. 132/2004 of the Ministry of Mining regulates occupational health and safety (OHS) measures in the mining sector with the objective to protect the life and physical integrity of all humans that work in or are related to the mining industry. It, furthermore, aims to protect facilities and infrastructure that allow mining operations and their continuance (MDNP 2018)(National Library of Congress 2017). In this framework, companies with more than 100 workers are required to have a Risk Prevention Department in place. This department is headed by an expert qualified by the National Geology and Mining Service</p>

	(SERNAGEOMIN). The development of plans and programs for the prevention of accidents and occupational diseases is mandatory (MDNP 2018). In general, employers are obliged to ensure the safety of employees, machines and buildings (through training, protective clothing, maintenance of machines). At the same time, employees must ensure that occupational safety and safety rules are observed and controlled (ICLG 2018).
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## Corporate Social Responsibility (CSR)

Voluntary Standards	
Aluminium Stewardship Initiative (ASI): Is the mine owning company a member?	Not applicable Not applicable
Aluminium Stewardship Initiative (ASI): Is the mine certified?	Not applicable Not applicable
International Council of Mining & Metals (ICMM): Is the mine owning company a member?	Yes Yes (ICMM 2018)
Towards Sustainable Mining (TSM) Is the mine owning company a member of the Mining Association of Canada (MAC)?	Yes Yes (MAC 2019)
Towards Sustainable Mining (TSM) outside Canada: Are TSM standards implemented*?	No information available No mention of application of TSM protocols outside of Canada in the Sustainability Report (BHP 2018c)

Initiative for Responsible Mining Assurance (IRMA): Is the mine owning company a member?	No No (IRMA 2018)
Initiative for Responsible Mining Assurance (IRMA): Is the mine certified?	No No (IRMA 2018)
Responsible Copper (RC): Is the mine owning company a member of RC?	No information available No information available
Responsible Copper (RC): Is the mine certified?	No information available No information available
Responsible Mining Index (RMI): Has the mine been rated?	1.33 / 6.00 1.33 / 6.00 (RMI 2018)
Responsible Mining Index Company indicator „Working conditions“	0.550 0.550 / 1.000 (RMI 2018)
Responsible Mining Index Company indicator „Environmental sustainability“	0.480 0.480 / 1.000 (RMI 2018)
Responsible Steel (RS): Is the mine owner a member of the RS?	Not applicable Not applicable
Responsible Steel (RS): Is the mine certified?	Not applicable Not applicable
Australian Steel Stewardship Forum (ASSF): Is the owner a member of the ASSF?	Not applicable Not applicable
Australian Steel Stewardship Forum: Is the mine certified?	Not applicable Not applicable
<b>ISO and CSR reporting</b>	
ISO 14001 (ISO 14004): Is the mine ISO 14001 certified?	Yes Yes (BHP 2002)

CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (Australia) (BHP 2018d)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (Australia) (OECD 2019)
ISO 26000: Does the mine implement ISO 26000?*	No information obtained No information available
<b>Banking Standards</b>	
WB Standards / IFC Performance Standards: Is the mine financed to a major extend by the world bank?	Yes The mine was financed by IFC in 1989 and 1999 (IFC n.d.). Until 2010 it was a minor shareholder (2.5%) of the mine (BNamericas 2010).
Equator Principles (EP): Is the mine financed to a major extend by a bank adherent to the EP?	No information obtained No information available

\*by companies own account.

## Sources

BHP (2002): Minera Escondida. Merrill Lynch investor visit. <https://www.bhp.com/-/media/bhp/documents/investors/reports/2002/escondidavisit181102.pdf>.

BHP (2017): Informe de Sustentabilidad 2017. Minera Escondida - Pampa Norte. [https://www.bhp.com/-/media/documents/media/reports-and-presentations/2018/180720\\_informedesustentabilidadbhpchile.pdf](https://www.bhp.com/-/media/documents/media/reports-and-presentations/2018/180720_informedesustentabilidadbhpchile.pdf)? (04.06.2020).

BHP (2018a): Annual Report 2018. <https://www.bhp.com/-/media/documents/investors/annual-reports/2018/bhpannualreport2018.pdf> (12.08.2019).

BHP (2018b): Dams and tailings management. In: BHP. <https://www.bhp.com/environment/dams-and-tailings-management>. (04.06.2020).

BHP (2018c): Sustainability Report 2018. <https://www.bhp.com/-/media/documents/investors/annual-reports/2018/bhpsustainabilityreport2018.pdf> (23.07.2019).

BHP (2018d): Global Head Office. <https://www.bhp.com/media-and-insights/news-releases/2013/09/global-head-office>. (04.06.2020).

BNamericas (2010): Escondida sale based on success of project -...

[https://www.bnamericas.com/en/news/Escondida\\_sale\\_based\\_on\\_success\\_of\\_project\\_-\\_IFC](https://www.bnamericas.com/en/news/Escondida_sale_based_on_success_of_project_-_IFC). (04.06.2020).

Consejo Minero (n.d.): Compañía Minera Doña Inés de Collahuasi SCM. <https://consejominero.cl/comunicaciones/plataforma-de-relaves/bhp-plataforma-de-relave/laguna-seca/>.

Darling, P. (2011): SME Mining Engineering Handbook. Society for Mining, Metallurgy, and Exploration, Inc. (SME).

Dehoust, G.; Manhart, A.; Möck, A.; Kießling, L.; Vogt, R.; Kämper, C.; Giegrich, J.; Auberger, A.; Priester, M.; Rechlin, A.; Dolega, P. (2017a): Erörterung ökologischer Grenzen der Primärrohstoffgewinnung und Entwicklung einer Methode zur Bewertung der ökologischen Rohstoffverfügbarkeit zur Weiterentwicklung des Kritikalitätskonzeptes (ökoRess I) - Konzeptband. Umweltbundesamt, Dessau-Roßlau.

Dehoust, G.; Manhart, A.; Möck, A.; Kießling, L.; Vogt, R.; Kämper, C.; Giegrich, J.; Auberger, A.; Priester, M.; Rechlin, A.; Dolega, P. (2017b): Erörterung ökologischer Grenzen der Primärrohstoffgewinnung und Entwicklung einer Methode zur Bewertung der ökologischen Rohstoffverfügbarkeit zur Weiterentwicklung des Kritikalitätskonzeptes (ökoRess I) - Methode für einen standortbezogenen Ansatz. Umweltbundesamt, Dessau-Roßlau.

EI SourceBook (2016): Text of the Law No 19.300 General Bases for the Environment, published on the official gazette on 9th of March 1994.

<http://www.eisourcebook.org/cms/February%202016/Chile%20General%20Environment%20Law%201994.pdf>. (28.12.2018).

Eyzaguirre, N. (2018): Chile: Mining Law 2019. In: International Comparative Legal Guides International Business Reports. Text,

<https://iclg.com/practice-areas/mining-laws-and-regulations/chile>. (10.09.2019).

ICMM (2018): Members. In: International Council on Mining and Metals (ICMM). <https://www.icmm.com/en-gb/members>. (13.05.2019).

IFC (n.d.): IFC Global Mining. In: International Finance Corporation (IFC). World Bank Group.

<https://www.ifc.org/wps/wcm/connect/434c0a0049a5f8cda3d0e3a8c6a8312a/IFC+Mining+Overview.pdf?MOD=AJPERES>.

IRMA (2014): Standard for Responsible Mining. Draft v1.0. Initiative for Responsible Mining Assurance (IRMA). [https://responsiblemining.net/wp-content/uploads/2018/09/IRMA\\_Standard\\_Draft\\_v1.007-14.pdf](https://responsiblemining.net/wp-content/uploads/2018/09/IRMA_Standard_Draft_v1.007-14.pdf).

IRMA (2018): Responsible Mining Map. In: Initiative for Responsible Mining Assurance (IRMA). <https://map.responsiblemining.net/>. (16.04.2019).

MAC (2019): Our Members. In: The Mining Association of Canada (MAC). <http://mining.ca/members-partners/our-members>. (16.04.2019).

MDNP (2018): Country Fiche Chile. In: EU - Latin America Mineral Development Network Platform (MDNP).

[https://www.mineralplatform.eu/system/files/CountryFiche/MDNP\\_country-fiche\\_Chile\\_02.pdf](https://www.mineralplatform.eu/system/files/CountryFiche/MDNP_country-fiche_Chile_02.pdf). (19.09.2019).

- Minehutte (2019): Chile - Mining & Environmental Law & Regulations. In: MineHutte - Regulatory Risk Ratings & Analysis of Global Mining Laws. <https://minehutte.com/jurisdiction/chile/>. (28.12.2018).
- Mining Technology (n.d.): Escondida Copper, Gold and Silver Mine, Atacama Desert. In: Mining Technology | Mining News and Views Updated Daily. <https://www.mining-technology.com/projects/escondida/>. (02.06.2020).
- OECD (2019): Member Countries. In: Organisation for Economic Co-operation and Development (OECD). <https://www.oecd.org/about/members-and-partners/>. (05.11.2019).
- Pfister, S.; Koehler, A.; Hellweg, S. (2009): Assessing the Environmental Impacts of Freshwater Consumption in LCA. In: Environmental science & technology. Vol. 43, No.11, S. 4098–4104.
- Risner, P.; Davies, P.; Wild, F.; Stapledon, G.; Quinn, B. (2018): BHP Sustainability Briefing. [https://www.bhp.com/-/media/documents/media/reports-and-presentations/2018/181010\\_bhpsustainabilitybriefing1.pdf?la=en](https://www.bhp.com/-/media/documents/media/reports-and-presentations/2018/181010_bhpsustainabilitybriefing1.pdf?la=en) (04.06.2020).
- RMI (2018): BHP - Company report. In: Responsible Mining Index (RMI). /en/companies/7. (13.06.2019).
- Rode, H. (2015): Escondida - Enhancing our competitive advantage. BHP Billiton Investor Briefing, Escondida [https://www.bhp.com/-/media/bhp/documents/investors/reports/2015/151202\\_coppersitetourday2.pdf?la=en](https://www.bhp.com/-/media/bhp/documents/investors/reports/2015/151202_coppersitetourday2.pdf?la=en) (04.06.2020).
- Tapia, J. S.; Valdés, J.; Orrego, R.; Tchernitchin, A.; Dorador, C.; Bolados, A.; Harrod, C. (2018): Geologic and anthropogenic sources of contamination in settled dust of a historic mining port city in northern Chile: health risk implications. In: PeerJ. PeerJ Inc. Vol. 6, S. 4699.
- UNEP (2019): Minamata Convention on Mercury: Parties and Signatories. In: UN Environment Programme (UNEP) - Minamata Convention on Mercury. <http://www.mercuryconvention.org/Countries/Parties/tabid/3428/language/en-US/Default.aspx>. (05.11.2019).
- UNFCCC (2016): Paris Agreement Signatories Rise to 187. In: United Nations Framework Convention on Climate Change (UNFCCC). <https://unfccc.int/news/malawi-armenia-zambia-and-chile-sign-paris-agreement>. (23.07.2019).
- Wendling, Z. A.; Emerson, J. W.; de Sherbinin, A.; Esty, D. C. (2020): 2020 Environmental Performance Index. Yale Center for Environmental Law & Policy, New Haven, CT. <https://epi.yale.edu/epi-results/2020/component/epi> (11.08.2020).
- WGI (2019): The Worldwide Governance Indicators (WGI). The World Bank. <http://info.worldbank.org/governance/WGI/#home>. (10.12.2018).

## A Glossary

Table 1 Legend

### Environmental hazard potential



*low*



*medium*



*high*

### Data quality



*low*



*medium*



*high*

- No concrete information, no general specifications of the measurement instructions, expert estimation.
- Assessment not possible due to lack of data at the site, as there is also no evidence for an assessment and there are no generalized assessment rules.

- Assessable on the basis of available information.
- Generalized classification according to measurement instructions.

- Can be derived directly from available data.

## B Abbreviations

EHP	Environmental hazard potential
FY	Financial year
kt	Kilo tonnes
m a.s.l.	Meters above sea level
Mt	Million tonnes
OHS	Occupational Health and Safety
t	tonnes
TSF	Tailing Storage Facility
WGI	World Governance Indicators
WHS	Work Health and Safety

## C Imprint

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