

# ÖkoRess III

## Pilot Screening of Environmental Hazard Potentials of Mine Sites

Factsheet:

**Tilden**

**Cleveland Cliffs Inc. , USA**

ID: 30

## 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>

# Tilden

## Iron ore

General information 	
Indicator or criteria	Description and values
Name of mine	Tilden
Description of mining area	The Tilden mine (comprises pit of about 230 m depth and a beneficiation plant) is located on the Marquette Iron Range in Michigan's Upper Peninsula immediately next and almost inseparable to the already decommissioned Empire Mine (Google Earth 5/16/2019) (EarthObservatory 2013). Hosted in the Proterozoic Negaunee Iron-Formation, the ore bearing strata of the banded iron formation type with mainly martite, siderite and magnetite and hematite bearing cherts (The Diggings 2019) are of the low grade taconite type. (Pietrzak 2011). A paragenetic sequence in the basal iron formation contains also chlorite, carbonate, Cu-Fe sulphide and remobilized apatite and monazite (Pietrzak 2011).
Surface extension	36.46km <sup>2</sup> 36.46 km <sup>2</sup> (Image date: 17.05.2019; Viewing height: 6.52km) (Google Earth)
In operation since	1974 1974 (Cliffs 2019a)
Operator	Cleveland Cliffs Inc.
Owner	Cleveland Cliffs Inc.
Closest town	approximately 8 km south of Ishpeming, Michigan.
Province	Michigan
Country	USA
Longitude	-87.656011°
Latitude	46.440185°

Altitude	400 m a.s.l. 400 m a.s.l (Google Earth)
Main product and by-products	Iron ore concentrates
On-site processing stages	Operations: open pit truck and shovel mine, concentrator with single stage crushing, AG mills, magnetite separation and floatation to produce hematite and magnetite concentrates; on-site pellet plant (Cliffs 2019b p. 33).
Annual production	2018: 7.82 Mt (= 7.7 M long tons, all long tons converted in toms)(Cliffs 2019b p. 33).
Proven Reserves	245.6 Mt (Cliffs 2019b p. 36)
Probable Reserves	84,0 Mt (Cliffs 2019b p. 36)

## Geology



Indicator or criteria	Description and values	Explanation	Assessment result	Data quality
Preconditions for acid mine drainage (AMD)	Although trace sulphide minerals are reported from the ore bearing sequence of Tilden (Pietrzak 2011 p. 46), Tilden was not reported by the EPA as AMD relevant (EPA 1994 pp. 1–40).	Iron is a siderophile element; therefore, no preconditions for acid mine drainage for this ore type is given. Considering the description and values obtained and according to the site-related Oekoress measurement instructions (Dehoust et al. 2017b), siderophile ore deposits are classified with a medium environmental hazard potential (EPH).	Medium	A = high, can be derived directly from available data
Paragenesis with heavy metals	The semi-metal Selenium has accumulated in sediments due to leaching from mine tailings at levels exceeding 2 mg/kg (GLIFWC 2011). It reaches tenth of micrograms per liter in	Although not a heavy metal, selenium is part of the substances characterised by their toxicity to animals and aerobic and anaerobic processes and listed in	High	A = high, can be derived directly from available data

	surface waters of the mine area (EGLE 2009 pp. i–iii). Liberation of mercury is related during milling and pelletizing process (Kerfoot et al 2018)	(Dehoust et al. 2017b p. 22). Consequently, and also considering the priority given to the environmental relevance of this element in the regional context of the mine, a high EPH is assigned.		
Paragenesis with radioactive components	No indication of paragenesis with thorium and uranium or other radioactive components were determined.	In accordance with the measurement instructions (Dehoust et al. 2017b), iron ore deposits are evaluated with a medium EHP, if no further information is available.	Medium	B1 = medium, can be estimated on the basis of available information
Deposit size	Total reserves (proven and probable) : 324.4 Mt (Cliffs 2019b)	Considering the total reserves of 324.4 Mt and adding the amount of iron ore extracted in the past (the Complex is in operation since 1974 = 44 years- with an average of 7.8 Mt/year = 343 Mt), the total deposit size sums up to about 668 Mt. Assuming an average grade of 34 % Fe the total Fe amounts to about 227 Mt. According to the measurement instructions (Dehoust et al. 2017b) the complex is thus classified as medium size and evaluated with a medium EPH.	Medium	B1 = medium, can be estimated on the basis of available information
Ore grade	34.4 % Fe (Cliffs 2019b)	With 34 % average ore grade of total reserves, the grade is considered medium grade in accordance with the measurement instructions (Dehoust et al. 2017b).	Medium	A = high, can be derived directly from available data

<b>Technology</b>				
Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Mine type	Open pit hard rock mining (Cliffs 2019b p. 33)	Mining is restricted to the horizontal and vertical extension of the ore body/mineralized zone; depleted pits are used for waste disposal. According to measurement instructions (Dehoust et al. 2017b) a Medium EHP can be assigned.	Medium	B1 = medium, can be estimated on the basis of available information
Use of auxiliary substances	Mining by truck and shovel-loader; drilling and blasting. One major beneficiation plant is in operation where processing standard procedures are carried out: crushing, classification, grinding, floating concentration and magnetic separation. Concentration steps such as the use of caustic soda and floatation with organic compounds like amines as collectors and starch depressants are utilised in Tilden (MSU n.d.).	This indicator is evaluated with a high EHP due to the use of potentially toxic substances.	High	B1 = medium, can be estimated on the basis of available information
Mining waste	Waste rock is typically put in large piles next to the mine pits, and tailings are discharged in tailing basins (Griben tailings basin, Tilden Water reuse pond (EarthObservatory 2013) (GLIFWC 2011), Tilden Gribben tailings has a dam height of about 35 m and a volume of almost 24.7 Mm <sup>3</sup> (20,000 ft acres) (NID 2018) Nearly all of the water used in the plant is re-	According to ICOLD (2018), the largest and highest Tilden mine dam is a large dam with 35 m height and a capacity of 24.7 Mm <sup>3</sup> . Thus, the indicator for the mine is classified with a high EHP.	High	B1 = medium, can be estimated on the basis of available information



	<p>circulated through the use of large tailing thickeners and a re-use water pond system (MSU n.d.).                  Furthermore stack emissions to the air during the firing of pellet are the dominant pathway for mercury release from taconite ore processing, as Hg(II) in ore concentrate is converted to Hg(0) (Kerfoot et al 2018).</p>			
Remediation measures	<p>Infrastructure needed for implementation of the storm water collection and conveyance system will likely be completed in 2020 (Cliffs 2019b p. 12).                  Neither in Empire nor Tilden Mine restoration measures can be observed in the Google Earth Image. Republic Wetlands Preserve promoted by Cliffs in the Republic mine surroundings benefit also Tilden mine (Eggelston 2012).</p>	<p>No further description of individual and comprehensive remediation measures besides the process parallel measures mentioned in the preceding (left) box is available. Financial accruals for restoration seem to exist but cannot be specified for the Tilden mine (Cliffs 2019b). For these reasons a medium EHP is assigned.</p>	Medium	B2 = medium, classified according to measurement instructions

## Framework conditions natural environment



Indicator or criteria	Description and values	Explanation	Evaluation result	Data quality
Accident hazard due to floods, earthquake, storms, landslides	<p>The rating system for the 4 sub-indicators uses georeferenced data from publicly available risk maps (see measurement instructions Dehoust et al. 2017b). Metrics are directly taken from the given risk assessment. The indicator total is</p>	<p>The Gribben tailing pond has a high Flood hazard potential. All remaining sub indicators for the mining area as well as for the tailing pond are low. For this reason, the high flood hazard of Gribben</p>	High	n.d.

	determined by the highest hazard level of the sub-indicators.	tailing pond determines the resulting high EHP.		
Water Stress Index (WSI) und desert areas	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 supplemented by desert areas. The highest hazard level of the sub-indicators determines the total result.	The water stress for the mining area and tailing pond is low and they are not situated in a desert area, which results in a low EHP.	Low	n.d.
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).	The mining area is situated in protected areas which results in a medium EHP.	Medium	n.d.

## State Governance

Indicators	
WGI 1 -Voice and Accountability	82.27 <sup>ooo</sup>
WGI 2 -Political Stability and Absence of Violence/ Terrorism	59.05 <sup>ooo</sup>
WGI 3 - Government Effectiveness	92.79 <sup>ooo</sup>
WGI 4 -Regulatory Quality	92.79 <sup>ooo</sup>

WGI 5 - Rule of Law	91.83 <sup>ooo</sup>
WGI 6 -Control of Corruption	88.94 <sup>ooo</sup>
EPI (Environmental Performance Index)	71.19
EITI membership	No (EITI 2019), the US joined the EITI in 2014 and withdrew from the EITI in 2017

**International Agreements**

ILO 176	Yes, ratified in 2001
Others	OECD member

**Legal framework**

Areas of Law: Environment	<p>The National Environmental Policy Act (NEPA) is the principal environmental law implicated by mining on federal lands. It requires federal agencies to take a “hard look” at the environmental consequences of its projects before action is taken. An agency must prepare an Environmental Impact Statement (EIS) for all major federal actions significantly affecting the quality of the human environment. The analysis generally requires consideration of other substantive environmental statutes and regulations, including the Clean Air Act, the Clean Water Act and the Endangered Species Act. State laws may also require environmental analysis. Third parties may sue the federal agency completing the review to ensure that the agency considered all relevant factors and had a rational basis for the decisions made based on the facts found. Prosecuting the litigation would extend the project approval time, and if the agency loses, additional time would be required for the agency to redo its flawed NEPA analysis (Kahalley 2018). The Clean Air Act is administered by the Environmental Protection Agency (EPA) and states with delegated authority. The Clean Water Act is administered by the EPA, the US Army Corps of Engineers, and states with delegated authority. The US Fish and Wildlife Service and National Marine Fisheries Service administer the Endangered Species Act. States also have a wide range of environmental laws that govern permitting and reclamation on mining projects. A variety of federal and state laws govern the storage of tailings and other waste products on mining operations and for the closure of mines. In general, a mine plan must provide a detailed description of how the mine operations will comply with such requirements (Kahalley 2018).</p> <p>The Federal Land Policy and Management Act (FLPMA) requires the US Bureau of Land Management (BLM) and the US Forest Service (USFS) to prevent unnecessary or undue degradation of public lands. BLM and USFS reclamation standards include saving topsoil for reshaping disturbed areas, erosion and water control measures, toxic materials measures, reshaping and re-vegetation where reasonably practicable, and rehabilitation of fish and wildlife habitat. State laws may also include closure and reclamation</p>
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	<p>requirements. Federal and state laws generally require financial guarantees prior to commencing operations to cover closure and reclamation costs (Kahalley 2018).</p>
<p>Areas of Law: Occupational Health and Safety (OHS)</p>	<p>The Federal Mine Safety and Health Act requires the Mine Safety and Health Administration (MSHA) to inspect all mines each year to ensure safe and healthy work environments. MSHA is prohibited from giving advance notice of an inspection, and may enter mine property without a warrant. MSHA regulations set out detailed safety and health standards for preventing hazardous and unhealthy conditions, including measures addressing fire prevention, air quality, explosives and others. MSHA regulations also establish requirements for: testing, evaluating, and approving mining products; miner and rescue team training programmes; and notification of accidents, injuries, and illnesses at the mine. Owners, employers, managers and employees all have obligations under the laws described in question (Kahalley 2018).</p>

## 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?	No No (ICMM 2019)
Towards Sustainable Mining (TSM) Is the mine owning company a member of the Mining Association of Canada (MAC)?	No No (MAC 2019)
Towards Sustainable Mining (TSM) outside Canada: Are TSM standards implemented*?	No information available No information obtained
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?	Not applicable Not applicable
Responsible Copper (RC): Is the mine certified?	No No (RMI 2018)
Responsible Mining Index (RMI): Has the mine been rated?	No No (RMI 2018)
Responsible Mining Index Company indicator „Working conditions“	Not applicable n.d.

Responsible Mining Index Company indicator „Environmental sustainability“	n.d. n.d.
Responsible Steel (RS): Is the mine owner a member of the RS?	No No (Responsible Steel 2019)
Responsible Steel (RS): Is the mine certified?	No No (Responsible Steel 2019)
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 (Cliffs 2019c)
CSR-directive 2014/95/EU: Does the mine owning company have its headquarters in an EU country?	No No (Cliffs 2019a)
OECD Guidelines: Does the company have its headquarters in a signatory state?	Yes Yes (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?	No information obtained No information available
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.

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## 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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