| FS Section | Content field | Explanation of content | CSR | eSDS |
|---|---|---|---|---|
| 1. Title | 1.1 Title of SPERC | Mining chemicals (industrial): solvent-borne | Y | Y |
| | 1.2 SPERC code | ESVOC SPERC 4.23a.v3 | Y | Y |
| 2. Scope | 2.1 Substance/Product Domain | | | |
| | Substance types / functions / properties included or excluded | Applicable to petroleum substances and petrochemicals. | Y | N |
| | Additional specification of product types covered: | Includes a variety of aliphatic and aromatic hydrocarbons, ketones, alcohols, acetates, glycols, glycol ethers, and glycol ether acetates. | Y | N |
| | Inclusion of sub-SPERCs | **No** | N | N |
| | 2.2 Process domain | | | |
| | Description of activities/processes: | Covers the use of the substance in extraction processes at mining operations, including material transfers, winning and separation activities, and substance recovery and disposal. | Y | Y |
| | 2.3 List of applicable Use Descriptors | | | |
| | LCS | IS – Use at industrial sites | Y | Y |
| | SU | SU2a – Mining (without offshore industries) | Y | Y |
| | PC | PC40 – Extraction agents | Y | Y |
| 3. Operational conditions | 3.1 Conditions of use | | | |
| | Location of use | Indoor | Y | Y |
| | Water contact during use | Yes | Y | Y |
| | Connected to a standard municipal biological STP | Yes | Y | Y |
| | Rigorously contained system with minimisation of release to the environment | No | Y | N |
| | Further operational conditions impacting on releases to the environment | Volatile compounds subject to air emission controls. Wastewater emissions generated from equipment cleaning with water. | Y | Y |
| | 3.2 Waste Handling and Disposal | | | |
| | Waste Handling and Disposal: | Residual raw materials and are in some cases recycled and fed back into the process reactor to improve efficiencies. In other cases, residues and by-products are used as raw materials for other downstream applications (EEA, 2016). Wastewater generated during cleaning and maintenance operations is directed to a waste water treatment plant for biological degradation. Atmospheric release of waste vapour may be ameliorated using wet scrubbers, thermal oxidizers, solid adsorbents, membrane separators, biofilters, and/or cold oxidizers for trapping residual vapours. All unrecovered waste is handled as an industrial waste that can be incinerated.<br>EU (2016). Best Available Techniques (BAT) Reference Document for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector. Report EUR 28112 EN. European IPPC Bureau. Seville, Spain.<br>http://eippcb.jrc.ec.europa.eu/reference/BREF/CWW_Bref_2016_published.pdf<br>EEA (2016). Prevention of hazardous waste in Europe — the status in 2015 European Environment Agency, Report No. 35/2016. Copenhagen, | Y | N |

| FS Section | Content field | Explanation of content | CSR | eSDS |
|---|---|---|---|---|
| | | Denmark. https://www.eea.europa.eu/publications/waste-prevention-in-europe/file | | |
| 4. Obligatory RMMs onsite | **RMM limiting release to air:** | No obligatory RMMs. | Y | Y |
| | **RMM Efficiency (air):** | Optional RMMs have been assigned a nominal removal efficiency value that is not accounted for in the air release factor. See the background document for more information. | Y | Y |
| | **Reference for RMM Efficiency (air):** | EU (2016). Best Available Techniques (BAT) Reference Document for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector. Report EUR 28112 EN. European IPPC Bureau. Seville, Spain. http://eippcb.jrc.ec.europa.eu/reference/BREF/CWW_Bref_2016_published.pdf | Y | N |
| | **RMM limiting release to water:** | Oil-water separation (e.g. *via* oil water separators, oil skimmers, or dissolved air flotation) is required. | Y | Y |
| | **RMM Efficiency (water):** | The efficiency of this RMM varies dependent on the treatment technology and the properties of the substance. | Y | Y |
| | **Reference for RMM Efficiency (water):** | EU (2016). Best Available Techniques (BAT) Reference Document for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector. Report EUR 28112 EN. European IPPC Bureau. Seville, Spain. http://eippcb.jrc.ec.europa.eu/reference/BREF/CWW_Bref_2016_published.pdf | Y | N |
| | **RMM limiting release to soil:** | The sludge generated from wastewater treatment is not applied to agricultural soil. | Y | Y |
| | **RMM Efficiency (soil):** | Not applicable | Y | Y |
| | **Reference for RMM Efficiency (soil):** | ECHA (2016). Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.16: Environmental Exposure Assessment Version 3.0. European Chemicals Agency. Helsinki, Finland. https://echa.europa.eu/documents/10162/13632/information_requirements_r16_en.pdf | Y | N |
| 5. Exposure Assessment Input | **5.1 Substance use rate** | | | |
| | **Amount of substance use per day:** | 10,000 kg/day | Y | Y |
| | **Fraction of EU tonnage used in region:** | 100% | Y | N |
| | **Fraction of Regional tonnage used locally:** | 100% | Y | N |
| | **Justification / information source:** | ECHA (2016). Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.16: Environmental Exposure Assessment Version 3.0. European Chemicals Agency. Helsinki, Finland. https://echa.europa.eu/documents/10162/13632/information_requirements_r16_en.pdf | Y | N |
| | **5.2 Days emitting** | | | |
| | **Number of emission days per year:** | 20 (default value) | Y | Y |
| | **Justification / information source:** | ECHA, 2016. Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.16: Environmental Exposure Assessment Version 3.0. European Chemicals Agency. Helsinki, Finland. https://echa.europa.eu/documents/10162/13632/information_requirements_r16_en.pdf | Y | N |
| | **5.3 Release factors** | | | |
| | **sub-SPERC identifier:** | ESVOC 4.23a.a.v3<br>WS <0.001 mg/l | Y | N |
| | **ERC** | ERC 4 | | |
| | **sub-SPERC applicability:** | Water solubility <0.001 mg/l | Y | N |

| FS Section | Content field | Explanation of content | CSR | eSDS |
|---|---|---|---|---|
| | **5.3.1 Release Factor – air** | | | |
| | **Numeric value / percent of input amount (Air)** | 4% | Y | Y |
| | **Justification of RFs (Air):** | The justification for this value originates with published information citing the release of volatile hydrocarbons from a copper mining site (Bishop et al., 1999). Using the annual release rate for volatiles at the site along with the rate of mining reagent use, a general estimate of the air release was obtained that was adjusted upward by 25-fold to ensure that could be applied to all mining operations.<br>Bishop, M.D., Gray, L.A., Greene, M.G., Bauer, K., Young, T.L., May, J., Evans, K.E., Amerson-Treat, I., 1999. Investigation of evaporative losses in solvent extraction circuits, in: Young, S.K., Dresinger, D.B., R.P., H., Dixon, D.G. (Eds.), Copper 99-Cobre-99 International Conference, The Minerals, Metals, and Materials Society, Phoenix, AZ. | Y | N |
| | **5.3.2 Release Factor – water** | | | |
| | **Numeric value / percent of input amount (Water):** | 0.0001% | Y | Y |
| | **Justification of RFs (Water):** | The factor was established after identifying the geometric mean for eight water solubility categories and factoring these values into an equation that considered the volume of wastewater generated per tonne of organic reagent used at open pit copper mines (Sikamo et al., 2016; Sole et al., 2008). The annual rates of organic reagent usage and wastewater generation yielded a wastewater generation factor of 900 m3/tonne. This value was used to calculate water release factors for each water solubility category.<br>Sikamo, J., Mulenga, S.B., Zimba, W., Katuta, B., 2008. Reagent optimisation at Konkolo Copper Mines, PLC, Ncchanga tailings leach plant, Chincgola, Zambia in: Choi, Y. (Ed.), Proceedings of the Sixth International Symposium for Hydrometallurgy Society of Mining, Metallurgy, and Exploration, Phoenix, AZ.<br>Sole, K.C., Prinsloo, A., Hardwick, E., 2016. Recovery of copper from Chilean mine waste waters, in: Drebenstedt, C., Paul, M. (Eds.), International Mine Waters Association Conference, Technische Universitat Bergakademie Freiberg, Leipzig, Germany. | Y | N |
| | **5.3.3 Release Factor – soil** | | | |
| | **Numeric value / percent of input amount (Soil):** | 5.0% | Y | Y |
| | **Justification of RFs (Soil):** | The potential for release considers the partitioning of mining reagents to the sludge that forms at the aqueous/organic interface of an ore extraction operation. The stated release factor considers the recovery and reuse of approximately 95% of the extracting reagents prior to disposal of the sludge via land application (Mukutuma et al., 2008; USEPA, 1994).<br>Mukutuma, A., Schwarz, N., Feather, A., 2008. Operation of a Flottweg Tricanter® centrifuge for crud treatment at Bwana Mkubwa solvent extraction plant, Proceedings of the International Solvent Extraction Conference, Tucson, AZ.<br>USEPA, 1994. Technical Resource Document: Extraction and Beneficiation of Ores and Minerals-Copper. EPA 530-R-94-031, U.S. Environmental Protection Agency, Office of Solid Waste. Washington, DC. https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/html/copper.html. | Y | N |
| | **5.3.4 Release Factor – waste** | | | |
| | **Percent of input amount disposed as waste:** | 0.003% | Y | N |
| | **Justification of RFs:** | The waste generation factor was taken from a life cycle assessment for the mining and smelting of copper (ICA, 2013). The value represents the amount of hazardous waste generated during copper cathode and copper concentrate production by mining sites on four continents. An uncertainty factor of 10 has been applied to this value based on the anticipated variability of this factor across different mining operations. | Y | N |

| FS Section | Content field | Explanation of content | CSR | eSDS |
|---|---|---|---|---|
| | | ICA (2013). Copper Environmental Profile. International Copper Association. Washington, DC. http://copperalliance.org/wordpress/wp-content/uploads/2017/12/ICA-EnvironmentalProfileHESD-201709-FINAL-LOWRES-1-1.pdf. | | |
| | **sub-SPERC identifier:** | ESVOC 4.23a.b.v3<br>WS 0.001-0.01 mg/l | Y | N |
| | **ERC** | ERC 4 | | |
| | **sub-SPERC applicability:** | Water solubility 0.001-0.01 mg/l | Y | N |
| | **5.3.1 Release Factor – air** | | | |
| | **Numeric value / percent of input amount (Air)** | 4% | Y | Y |
| | **Justification of RFs (Air):** | The justification for this value originates with published information citing the release of volatile hydrocarbons from a copper mining site (Bishop et al., 1999). Using the annual release rate for volatiles at the site along with the rate of mining reagent use, a general estimate of the air release was obtained that was adjusted upward by 25-fold to ensure that could be applied to all mining operations.<br>Bishop, M.D., Gray, L.A., Greene, M.G., Bauer, K., Young, T.L., May, J., Evans, K.E., Amerson-Treat, I., 1999. Investigation of evaporative losses in solvent extraction circuits, in: Young, S.K., Dresinger, D.B., R.P., H., Dixon, D.G. (Eds.), Copper 99-Cobre-99 International Conference, The Minerals, Metals, and Materials Society, Phoenix, AZ. | Y | N |
| | **5.3.2 Release Factor – water** | | | |
| | **Numeric value / percent of input amount (Water):** | 0.0003% | Y | Y |
| | **Justification of RFs (Water):** | The factor was established after identifying the geometric mean for eight water solubility categories and factoring these values into an equation that considered the volume of wastewater generated per tonne of organic reagent used at open pit copper mines (Sikamo et al., 2016; Sole et al., 2008). The annual rates of organic reagent usage and wastewater generation yielded a wastewater generation factor of 900 m3/tonne. This value was used to calculate water release factors for each water solubility category.<br>Sikamo, J., Mulenga, S.B., Zimba, W., Katuta, B., 2008. Reagent optimisation at Konkolo Copper Mines, PLC, Ncchanga tailings leach plant, Chincgola, Zambia in: Choi, Y. (Ed.), Proceedings of the Sixth International Symposium for Hydrometallurgy Society of Mining, Metallurgy, and Exploration, Phoenix, AZ.<br>Sole, K.C., Prinsloo, A., Hardwick, E., 2016. Recovery of copper from Chilean mine waste waters, in: Drebenstedt, C., Paul, M. (Eds.), International Mine Waters Association Conference, Technische Universitat Bergakademie Freiberg, Leipzig, Germany. | Y | N |
| | **5.3.3 Release Factor – soil** | | | |
| | **Numeric value / percent of input amount (Soil):** | 5.0% | Y | Y |
| | **Justification of RFs (Soil):** | The potential for release considers the partitioning of mining reagents to the sludge that forms at the aqueous/organic interface of an ore extraction operation. The stated release factor considers the recovery and reuse of approximately 95% of the extracting reagents prior to disposal of the sludge via land application (Mukutuma et al., 2008; USEPA, 1994).<br>Mukutuma, A., Schwarz, N., Feather, A., 2008. Operation of a Flottweg Tricanter® centrifuge for crud treatment at Bwana Mkubwa solvent extraction plant, Proceedings of the International Solvent Extraction Conference, Tucson, AZ.<br>USEPA, 1994. Technical Resource Document: Extraction and Beneficiation of Ores and Minerals-Copper. EPA 530-R-94-031, U.S. Environmental Protection Agency, Office of Solid Waste. Washington, DC. | Y | N |

| FS Section | Content field | Explanation of content | CSR | eSDS |
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| | | https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/html/copper.html. | | |
| | **5.3.4 Release Factor – waste** | | | |
| | **Percent of input amount disposed as waste:** | 0.003% | Y | N |
| | **Justification of RFs:** | The waste generation factor was taken from a life cycle assessment for the mining and smelting of copper (ICA, 2013). The value represents the amount of hazardous waste generated during copper cathode and copper concentrate production by mining sites on four continents. An uncertainty factor of 10 has been applied to this value based on the anticipated variability of this factor across different mining operations.<br>ICA (2013). Copper Environmental Profile. International Copper Association. Washington, DC. http://copperalliance.org/wordpress/wp-content/uploads/2017/12/ICA-EnvironmentalProfileHESD-201709-FINAL-LOWRES-1-1.pdf. | Y | N |
| | **sub-SPERC identifier:** | ESVOC 4.23a.c.v3<br>WS 0.01-0.1 mg/l | Y | N |
| | **ERC** | ERC 4 | | |
| | **sub-SPERC applicability:** | Water solubility 0.01-0.1 mg/l | Y | N |
| | **5.3.1 Release Factor – air** | | | |
| | **Numeric value / percent of input amount (Air)** | 4% | Y | Y |
| | **Justification of RFs (Air):** | The justification for this value originates with published information citing the release of volatile hydrocarbons from a copper mining site (Bishop et al., 1999). Using the annual release rate for volatiles at the site along with the rate of mining reagent use, a general estimate of the air release was obtained that was adjusted upward by 25-fold to ensure that could be applied to all mining operations.<br>Bishop, M.D., Gray, L.A., Greene, M.G., Bauer, K., Young, T.L., May, J., Evans, K.E., Amerson-Treat, I., 1999. Investigation of evaporative losses in solvent extraction circuits, in: Young, S.K., Dresinger, D.B., R.P., H., Dixon, D.G. (Eds.), Copper 99-Cobre-99 International Conference, The Minerals, Metals, and Materials Society, Phoenix, AZ. | Y | N |
| | **5.3.2 Release Factor – water** | | | |
| | **Numeric value / percent of input amount (Water):** | 0.003% | Y | Y |
| | **Justification of RFs (Water):** | The factor was established after identifying the geometric mean for eight water solubility categories and factoring these values into an equation that considered the volume of wastewater generated per tonne of organic reagent used at open pit copper mines (Sikamo et al., 2016; Sole et al., 2008). The annual rates of organic reagent usage and wastewater generation yielded a wastewater generation factor of 900 m3/tonne. This value was used to calculate water release factors for each water solubility category.<br>Sikamo, J., Mulenga, S.B., Zimba, W., Katuta, B., 2008. Reagent optimisation at Konkolo Copper Mines, PLC, Ncchanga tailings leach plant, Chincgola, Zambia in: Choi, Y. (Ed.), Proceedings of the Sixth International Symposium for Hydrometallurgy Society of Mining, Metallurgy, and Exploration, Phoenix, AZ.<br>Sole, K.C., Prinsloo, A., Hardwick, E., 2016. Recovery of copper from Chilean mine waste waters, in: Drebenstedt, C., Paul, M. (Eds.), International Mine Waters Association Conference, Technische Universitat Bergakademie Freiberg, Leipzig, Germany. | Y | N |
| | **5.3.3 Release Factor – soil** | | | |
| | **Numeric value / percent of input amount (Soil):** | 5.0% | Y | Y |

| FS Section | Content field | Explanation of content | CSR | eSDS |
|---|---|---|---|---|
| | **Justification of RFs (Soil):** | The potential for release considers the partitioning of mining reagents to the sludge that forms at the aqueous/organic interface of an ore extraction operation. The stated release factor considers the recovery and reuse of approximately 95% of the extracting reagents prior to disposal of the sludge via land application (Mukutuma et al., 2008; USEPA, 1994).<br>Mukutuma, A., Schwarz, N., Feather, A., 2008. Operation of a Flottweg Tricanter® centrifuge for crud treatment at Bwana Mkubwa solvent extraction plant, Proceedings of the International Solvent Extraction Conference, Tucson, AZ.<br>USEPA, 1994. Technical Resource Document: Extraction and Beneficiation of Ores and Minerals-Copper. EPA 530-R-94-031, U.S. Environmental Protection Agency, Office of Solid Waste. Washington, DC.<br>https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/html/copper.html. | Y | N |
| | **5.3.4 Release Factor – waste** | | | |
| | **Percent of input amount disposed as waste:** | 0.003% | Y | N |
| | **Justification of RFs:** | The waste generation factor was taken from a life cycle assessment for the mining and smelting of copper (ICA, 2013). The value represents the amount of hazardous waste generated during copper cathode and copper concentrate production by mining sites on four continents. An uncertainty factor of 10 has been applied to this value based on the anticipated variability of this factor across different mining operations.<br>ICA (2013). Copper Environmental Profile. International Copper Association. Washington, DC. http://copperalliance.org/wordpress/wp-content/uploads/2017/12/ICA-EnvironmentalProfileHESD-201709-FINAL-LOWRES-1-1.pdf. | Y | N |
| | **sub-SPERC identifier:** | ESVOC 4.23a.d.v3<br>WS 0.1-1.0 mg/l | Y | N |
| | **ERC** | ERC 4 | | |
| | **sub-SPERC applicability:** | Water solubility 0.1-1.0 mg/l | Y | N |
| | **5.3.1 Release Factor – air** | | | |
| | **Numeric value / percent of input amount (Air)** | 4% | Y | Y |
| | **Justification of RFs (Air):** | The justification for this value originates with published information citing the release of volatile hydrocarbons from a copper mining site (Bishop et al., 1999). Using the annual release rate for volatiles at the site along with the rate of mining reagent use, a general estimate of the air release was obtained that was adjusted upward by 25-fold to ensure that could be applied to all mining operations.<br>Bishop, M.D., Gray, L.A., Greene, M.G., Bauer, K., Young, T.L., May, J., Evans, K.E., Amerson-Treat, I., 1999. Investigation of evaporative losses in solvent extraction circuits, in: Young, S.K., Dresinger, D.B., R.P., H., Dixon, D.G. (Eds.), Copper 99-Cobre-99 International Conference, The Minerals, Metals, and Materials Society, Phoenix, AZ. | Y | N |
| | **5.3.2 Release Factor – water** | | | |
| | **Numeric value / percent of input amount (Water):** | 0.03% | Y | Y |
| | **Justification of RFs (Water):** | The factor was established after identifying the geometric mean for eight water solubility categories and factoring these values into an equation that considered the volume of wastewater generated per tonne of organic reagent used at open pit copper mines (Sikamo et al., 2016; Sole et al., 2008). The annual rates of organic reagent usage and wastewater generation yielded a wastewater generation factor of 900 m3/tonne. This value was used to calculate water release factors for each water solubility category.<br>Sikamo, J., Mulenga, S.B., Zimba, W., Katuta, B., 2008. Reagent optimisation at Konkolo Copper Mines, PLC, Ncchanga tailings leach | Y | N |

| FS Section | Content field | Explanation of content | CSR | eSDS |
|---|---|---|---|---|
| | | plant, Chincgola, Zambia in: Choi, Y. (Ed.), Proceedings of the Sixth International Symposium for Hydrometallurgy Society of Mining, Metallurgy, and Exploration, Phoenix, AZ.<br>Sole, K.C., Prinsloo, A., Hardwick, E., 2016. Recovery of copper from Chilean mine waste waters, in: Drebenstedt, C., Paul, M. (Eds.), International Mine Waters Association Conference, Technische Universitat Bergakademie Freiberg, Leipzig, Germany. | | |
| | **5.3.3 Release Factor – soil** | | | |
| | **Numeric value / percent of input amount (Soil):** | 5.0% | Y | Y |
| | **Justification of RFs (Soil):** | The potential for release considers the partitioning of mining reagents to the sludge that forms at the aqueous/organic interface of an ore extraction operation. The stated release factor considers the recovery and reuse of approximately 95% of the extracting reagents prior to disposal of the sludge via land application (Mukutuma et al., 2008; USEPA, 1994).<br>Mukutuma, A., Schwarz, N., Feather, A., 2008. Operation of a Flottweg Tricanter® centrifuge for crud treatment at Bwana Mkubwa solvent extraction plant, Proceedings of the International Solvent Extraction Conference, Tucson, AZ.<br>USEPA, 1994. Technical Resource Document: Extraction and Beneficiation of Ores and Minerals-Copper. EPA 530-R-94-031, U.S. Environmental Protection Agency, Office of Solid Waste. Washington, DC.<br>https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/html/copper.html. | Y | N |
| | **5.3.4 Release Factor – waste** | | | |
| | **Percent of input amount disposed as waste:** | 0.003% | Y | N |
| | **Justification of RFs:** | The waste generation factor was taken from a life cycle assessment for the mining and smelting of copper (ICA, 2013). The value represents the amount of hazardous waste generated during copper cathode and copper concentrate production by mining sites on four continents. An uncertainty factor of 10 has been applied to this value based on the anticipated variability of this factor across different mining operations.<br>ICA (2013). Copper Environmental Profile. International Copper Association. Washington, DC. http://copperalliance.org/wordpress/wp-content/uploads/2017/12/ICA-EnvironmentalProfileHESD-201709-FINAL-LOWRES-1-1.pdf. | Y | N |
| | **sub-SPERC identifier:** | ESVOC 4.23a.e.v3<br>WS 1-10 mg/l | Y | N |
| | **ERC** | ERC 4 | | |
| | **sub-SPERC applicability:** | Water solubility 1-10 mg/l | Y | N |
| | **5.3.1 Release Factor – air** | | | |
| | **Numeric value / percent of input amount (Air)** | 4% | Y | Y |
| | **Justification of RFs (Air):** | The justification for this value originates with published information citing the release of volatile hydrocarbons from a copper mining site (Bishop et al., 1999). Using the annual release rate for volatiles at the site along with the rate of mining reagent use, a general estimate of the air release was obtained that was adjusted upward by 25-fold to ensure that could be applied to all mining operations.<br>Bishop, M.D., Gray, L.A., Greene, M.G., Bauer, K., Young, T.L., May, J., Evans, K.E., Amerson-Treat, I., 1999. Investigation of evaporative losses in solvent extraction circuits, in: Young, S.K., Dresinger, D.B., R.P., H., Dixon, D.G. (Eds.), Copper 99-Cobre-99 International Conference, The Minerals, Metals, and Materials Society, Phoenix, AZ. | Y | N |
| | **5.3.2 Release Factor – water** | | | |

| FS Section | Content field | Explanation of content | CSR | eSDS |
|---|---|---|---|---|
| | **Numeric value / percent of input amount (Water):** | 0.3% | Y | Y |
| | **Justification of RFs (Water):** | The factor was established after identifying the geometric mean for eight water solubility categories and factoring these values into an equation that considered the volume of wastewater generated per tonne of organic reagent used at open pit copper mines (Sikamo et al., 2016; Sole et al., 2008). The annual rates of organic reagent usage and wastewater generation yielded a wastewater generation factor of 900 m3/tonne. This value was used to calculate water release factors for each water solubility category.<br>Sikamo, J., Mulenga, S.B., Zimba, W., Katuta, B., 2008. Reagent optimisation at Konkolo Copper Mines, PLC, Ncchanga tailings leach plant, Chincgola, Zambia in: Choi, Y. (Ed.), Proceedings of the Sixth International Symposium for Hydrometallurgy Society of Mining, Metallurgy, and Exploration, Phoenix, AZ.<br>Sole, K.C., Prinsloo, A., Hardwick, E., 2016. Recovery of copper from Chilean mine waste waters, in: Drebenstedt, C., Paul, M. (Eds.), International Mine Waters Association Conference, Technische Universitat Bergakademie Freiberg, Leipzig, Germany. | Y | N |
| | **5.3.3 Release Factor – soil** | | | |
| | **Numeric value / percent of input amount (Soil):** | 5.0% | Y | Y |
| | **Justification of RFs (Soil):** | The potential for release considers the partitioning of mining reagents to the sludge that forms at the aqueous/organic interface of an ore extraction operation. The stated release factor considers the recovery and reuse of approximately 95% of the extracting reagents prior to disposal of the sludge via land application (Mukutuma et al., 2008; USEPA, 1994).<br>Mukutuma, A., Schwarz, N., Feather, A., 2008. Operation of a Flottweg Tricanter® centrifuge for crud treatment at Bwana Mkubwa solvent extraction plant, Proceedings of the International Solvent Extraction Conference, Tucson, AZ.<br>USEPA, 1994. Technical Resource Document: Extraction and Beneficiation of Ores and Minerals-Copper. EPA 530-R-94-031, U.S. Environmental Protection Agency, Office of Solid Waste. Washington, DC.<br>https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/html/copper.html. | Y | N |
| | **5.3.4 Release Factor – waste** | | | |
| | **Percent of input amount disposed as waste:** | 0.003% | Y | N |
| | **Justification of RFs:** | The waste generation factor was taken from a life cycle assessment for the mining and smelting of copper (ICA, 2013). The value represents the amount of hazardous waste generated during copper cathode and copper concentrate production by mining sites on four continents. An uncertainty factor of 10 has been applied to this value based on the anticipated variability of this factor across different mining operations.<br>ICA (2013). Copper Environmental Profile. International Copper Association. Washington, DC. http://copperalliance.org/wordpress/wp-content/uploads/2017/12/ICA-EnvironmentalProfileHESD-201709-FINAL-LOWRES-1-1.pdf. | Y | N |
| | **sub-SPERC identifier:** | ESVOC 4.23a.f.v3<br>WS 10-100 mg/l | Y | N |
| | **ERC** | ERC 4 | | |
| | **sub-SPERC applicability:** | Water solubility 10-100 mg/l | Y | N |
| | **5.3.1 Release Factor – air** | | | |
| | **Numeric value / percent of input amount (Air)** | 4% | Y | Y |

| FS Section | Content field | Explanation of content | CSR | eSDS |
|---|---|---|---|---|
| | **Justification of RFs (Air):** | The justification for this value originates with published information citing the release of volatile hydrocarbons from a copper mining site (Bishop et al., 1999). Using the annual release rate for volatiles at the site along with the rate of mining reagent use, a general estimate of the air release was obtained that was adjusted upward by 25-fold to ensure that could be applied to all mining operations.<br>Bishop, M.D., Gray, L.A., Greene, M.G., Bauer, K., Young, T.L., May, J., Evans, K.E., Amerson-Treat, I., 1999. Investigation of evaporative losses in solvent extraction circuits, in: Young, S.K., Dresinger, D.B., R.P., H., Dixon, D.G. (Eds.), Copper 99-Cobre-99 International Conference, The Minerals, Metals, and Materials Society, Phoenix, AZ. | Y | N |
| | **5.3.2 Release Factor – water** | | | |
| | **Numeric value / percent of input amount (Water):** | 3% | Y | Y |
| | **Justification of RFs (Water):** | The factor was established after identifying the geometric mean for eight water solubility categories and factoring these values into an equation that considered the volume of wastewater generated per tonne of organic reagent used at open pit copper mines (Sikamo et al., 2016; Sole et al., 2008). The annual rates of organic reagent usage and wastewater generation yielded a wastewater generation factor of 900 m3/tonne. This value was used to calculate water release factors for each water solubility category.<br>Sikamo, J., Mulenga, S.B., Zimba, W., Katuta, B., 2008. Reagent optimisation at Konkolo Copper Mines, PLC, Ncchanga tailings leach plant, Chincgola, Zambia in: Choi, Y. (Ed.), Proceedings of the Sixth International Symposium for Hydrometallurgy Society of Mining, Metallurgy, and Exploration, Phoenix, AZ.<br>Sole, K.C., Prinsloo, A., Hardwick, E., 2016. Recovery of copper from Chilean mine waste waters, in: Drebenstedt, C., Paul, M. (Eds.), International Mine Waters Association Conference, Technische Universitat Bergakademie Freiberg, Leipzig, Germany. | Y | N |
| | **5.3.3 Release Factor – soil** | | | |
| | **Numeric value / percent of input amount (Soil):** | 5.0% | Y | Y |
| | **Justification of RFs (Soil):** | The potential for release considers the partitioning of mining reagents to the sludge that forms at the aqueous/organic interface of an ore extraction operation. The stated release factor considers the recovery and reuse of approximately 95% of the extracting reagents prior to disposal of the sludge via land application (Mukutuma et al., 2008; USEPA, 1994).<br>Mukutuma, A., Schwarz, N., Feather, A., 2008. Operation of a Flottweg Tricanter® centrifuge for crud treatment at Bwana Mkubwa solvent extraction plant, Proceedings of the International Solvent Extraction Conference, Tucson, AZ.<br>USEPA, 1994. Technical Resource Document: Extraction and Beneficiation of Ores and Minerals-Copper. EPA 530-R-94-031, U.S. Environmental Protection Agency, Office of Solid Waste. Washington, DC.<br>https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/html/copper.html. | Y | N |
| | **5.3.4 Release Factor – waste** | | | |
| | **Percent of input amount disposed as waste:** | 0.003% | Y | N |
| | **Justification of RFs:** | The waste generation factor was taken from a life cycle assessment for the mining and smelting of copper (ICA, 2013). The value represents the amount of hazardous waste generated during copper cathode and copper concentrate production by mining sites on four continents. An uncertainty factor of 10 has been applied to this value based on the anticipated variability of this factor across different mining operations.<br>ICA (2013). Copper Environmental Profile. International Copper Association. Washington, DC. http://copperalliance.org/wordpress/wp- | Y | N |

| FS Section | Content field | Explanation of content | CSR | eSDS |
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| | | content/uploads/2017/12/ICA-EnvironmentalProfileHESD-201709-FINAL-LOWRES-1-1.pdf. | | |
| | **sub-SPERC identifier:** | ESVOC 4.23a.g.v3<br>WS 100-1000 mg/l | Y | N |
| | **ERC** | ERC 4 | | |
| | **sub-SPERC applicability:** | Water solubility 100-1000 mg/l | Y | N |
| | **5.3.1 Release Factor – air** | | | |
| | **Numeric value / percent of input amount (Air)** | 4% | Y | Y |
| | **Justification of RFs (Air):** | The justification for this value originates with published information citing the release of volatile hydrocarbons from a copper mining site (Bishop et al., 1999). Using the annual release rate for volatiles at the site along with the rate of mining reagent use, a general estimate of the air release was obtained that was adjusted upward by 25-fold to ensure that could be applied to all mining operations.<br>Bishop, M.D., Gray, L.A., Greene, M.G., Bauer, K., Young, T.L., May, J., Evans, K.E., Amerson-Treat, I., 1999. Investigation of evaporative losses in solvent extraction circuits, in: Young, S.K., Dresinger, D.B., R.P., H., Dixon, D.G. (Eds.), Copper 99-Cobre-99 International Conference, The Minerals, Metals, and Materials Society, Phoenix, AZ. | Y | N |
| | **5.3.2 Release Factor – water** | | | |
| | **Numeric value / percent of input amount (Water):** | 30% | Y | Y |
| | **Justification of RFs (Water):** | The factor was established after identifying the geometric mean for eight water solubility categories and factoring these values into an equation that considered the volume of wastewater generated per tonne of organic reagent used at open pit copper mines (Sikamo et al., 2016; Sole et al., 2008). The annual rates of organic reagent usage and wastewater generation yielded a wastewater generation factor of 900 m3/tonne. This value was used to calculate water release factors for each water solubility category.<br>Sikamo, J., Mulenga, S.B., Zimba, W., Katuta, B., 2008. Reagent optimisation at Konkolo Copper Mines, PLC, Ncchanga tailings leach plant, Chincgola, Zambia in: Choi, Y. (Ed.), Proceedings of the Sixth International Symposium for Hydrometallurgy Society of Mining, Metallurgy, and Exploration, Phoenix, AZ.<br>Sole, K.C., Prinsloo, A., Hardwick, E., 2016. Recovery of copper from Chilean mine waste waters, in: Drebenstedt, C., Paul, M. (Eds.), International Mine Waters Association Conference, Technische Universitat Bergakademie Freiberg, Leipzig, Germany. | Y | N |
| | **5.3.3 Release Factor – soil** | | | |
| | **Numeric value / percent of input amount (Soil):** | 5.0% | Y | Y |
| | **Justification of RFs (Soil):** | The potential for release considers the partitioning of mining reagents to the sludge that forms at the aqueous/organic interface of an ore extraction operation. The stated release factor considers the recovery and reuse of approximately 95% of the extracting reagents prior to disposal of the sludge via land application (Mukutuma et al., 2008; USEPA, 1994).<br>Mukutuma, A., Schwarz, N., Feather, A., 2008. Operation of a Flottweg Tricanter® centrifuge for crud treatment at Bwana Mkubwa solvent extraction plant, Proceedings of the International Solvent Extraction Conference, Tucson, AZ.<br>USEPA, 1994. Technical Resource Document: Extraction and Beneficiation of Ores and Minerals-Copper. EPA 530-R-94-031, U.S. Environmental Protection Agency, Office of Solid Waste. Washington, DC.<br>https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/html/copper.html. | Y | N |

| FS Section | Content field | Explanation of content | CSR | eSDS |
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| | **5.3.4 Release Factor – waste** | | | |
| | **Percent of input amount disposed as waste:** | 0.003% | Y | N |
| | **Justification of RFs:** | The waste generation factor was taken from a life cycle assessment for the mining and smelting of copper (ICA, 2013). The value represents the amount of hazardous waste generated during copper cathode and copper concentrate production by mining sites on four continents. An uncertainty factor of 10 has been applied to this value based on the anticipated variability of this factor across different mining operations.<br>ICA (2013). Copper Environmental Profile. International Copper Association. Washington, DC. http://copperalliance.org/wordpress/wp-content/uploads/2017/12/ICA-EnvironmentalProfileHESD-201709-FINAL-LOWRES-1-1.pdf. | Y | N |
| | **sub-SPERC identifier:** | ESVOC 4.23a.h.v3<br>WS >1000 mg/l | Y | N |
| | **ERC** | ERC 4 | | |
| | **sub-SPERC applicability:** | Water solubility >1000 mg/l | Y | N |
| | **5.3.1 Release Factor – air** | | | |
| | **Numeric value / percent of input amount (Air)** | 4% | Y | Y |
| | **Justification of RFs (Air):** | The justification for this value originates with published information citing the release of volatile hydrocarbons from a copper mining site (Bishop et al., 1999). Using the annual release rate for volatiles at the site along with the rate of mining reagent use, a general estimate of the air release was obtained that was adjusted upward by 25-fold to ensure that could be applied to all mining operations.<br>Bishop, M.D., Gray, L.A., Greene, M.G., Bauer, K., Young, T.L., May, J., Evans, K.E., Amerson-Treat, I., 1999. Investigation of evaporative losses in solvent extraction circuits, in: Young, S.K., Dresinger, D.B., R.P., H., Dixon, D.G. (Eds.), Copper 99-Cobre-99 International Conference, The Minerals, Metals, and Materials Society, Phoenix, AZ. | Y | N |
| | **5.3.2 Release Factor – water** | | | |
| | **Numeric value / percent of input amount (Water):** | 90% | Y | Y |
| | **Justification of RFs (Water):** | The factor was established after identifying the geometric mean for eight water solubility categories and factoring these values into an equation that considered the volume of wastewater generated per tonne of organic reagent used at open pit copper mines (Sikamo et al., 2016; Sole et al., 2008). The annual rates of organic reagent usage and wastewater generation yielded a wastewater generation factor of 900 m3/tonne. This value was used to calculate water release factors for each water solubility category.<br>Sikamo, J., Mulenga, S.B., Zimba, W., Katuta, B., 2008. Reagent optimisation at Konkolo Copper Mines, PLC, Ncchanga tailings leach plant, Chincgola, Zambia in: Choi, Y. (Ed.), Proceedings of the Sixth International Symposium for Hydrometallurgy Society of Mining, Metallurgy, and Exploration, Phoenix, AZ.<br>Sole, K.C., Prinsloo, A., Hardwick, E., 2016. Recovery of copper from Chilean mine waste waters, in: Drebenstedt, C., Paul, M. (Eds.), International Mine Waters Association Conference, Technische Universitat Bergakademie Freiberg, Leipzig, Germany. | Y | N |
| | **5.3.3 Release Factor – soil** | | | |
| | **Numeric value / percent of input amount (Soil):** | 5.0% | Y | Y |
| | **Justification of RFs (Soil):** | The potential for release considers the partitioning of mining reagents to the sludge that forms at the aqueous/organic interface of an ore extraction operation. The stated release factor considers the recovery and reuse of | Y | N |

| FS Section | Content field | Explanation of content | CSR | eSDS |
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| | | approximately 95% of the extracting reagents prior to disposal of the sludge via land application (Mukutuma et al., 2008; USEPA, 1994).<br>Mukutuma, A., Schwarz, N., Feather, A., 2008. Operation of a Flottweg Tricanter® centrifuge for crud treatment at Bwana Mkubwa solvent extraction plant, Proceedings of the International Solvent Extraction Conference, Tucson, AZ.<br>USEPA, 1994. Technical Resource Document: Extraction and Beneficiation of Ores and Minerals-Copper. EPA 530-R-94-031, U.S. Environmental Protection Agency, Office of Solid Waste. Washington, DC.<br>https://archive.epa.gov/epawaste/nonhaz/industrial/special/web/html/copper.html. | | |
| | **5.3.4 Release Factor – waste** | | | |
| | **Percent of input amount disposed as waste:** | 0.003% | Y | N |
| | **Justification of RFs:** | The waste generation factor was taken from a life cycle assessment for the mining and smelting of copper (ICA, 2013). The value represents the amount of hazardous waste generated during copper cathode and copper concentrate production by mining sites on four continents. An uncertainty factor of 10 has been applied to this value based on the anticipated variability of this factor across different mining operations.<br>ICA (2013). Copper Environmental Profile. International Copper Association. Washington, DC. http://copperalliance.org/wordpress/wp-content/uploads/2017/12/ICA-EnvironmentalProfileHESD-201709-FINAL-LOWRES-1-1.pdf. | Y | N |
| **References to SPERC Background Document** | | | | |
| | Reference to Background Document | ESIG/ESVOC (2023). SpERC Background Document. Specific Environmental Release Categories (SpERCs) for the use of solvents and solvent borne substances in the industrial production and/or use of water treatment chemicals, polymers, mining chemicals, and fuels. European Solvents Industry Group. Brussels, Belgium. | Y | N |