

Ferrochrome Processing: Are the Impacts Worth the Benefits?



Ugo Lapointe, B.Sc.H

Canada Program Coordinator

Environment North AGM Public Conference

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Presentation Today

1. MiningWatch Canada
2. Health Issues
3. Environmental Issues
4. Ferrochrome Plant in Finland
5. Conclusion

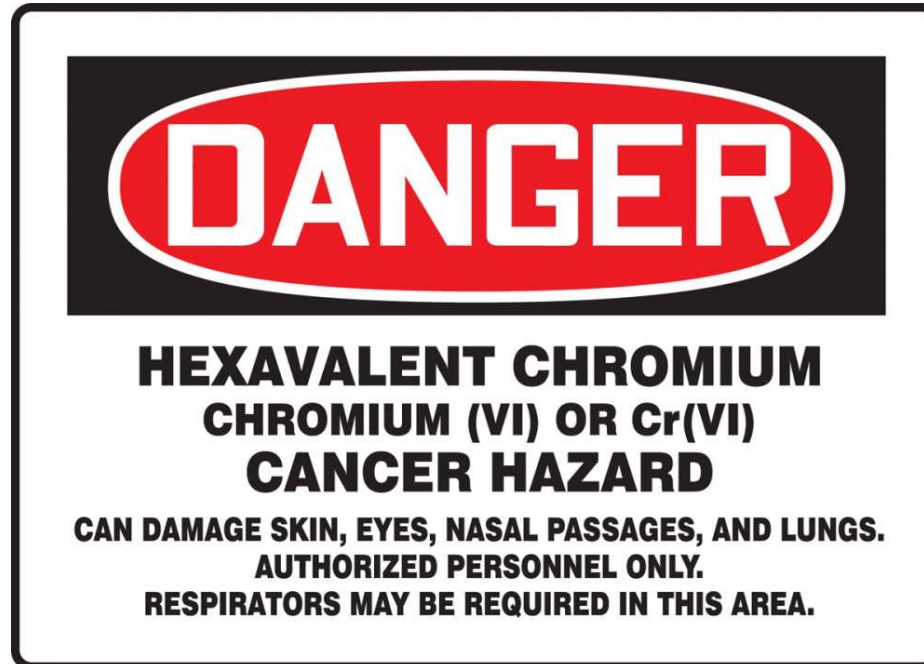
Health Issues

UNWHO - International Agency Research on Cancer (ICAR)

US Department of Health & Human Services (2012)

Environment & Health Canada (2015-2017)

Wu & al. (2016) and more...



Health Issues – Drinking Water

Federal-Provincial-Territorial Committee on Drinking Water 2015
Health Canada 2015



*All forms of chromium should be removed from drinking water because Cr-3 will oxidize to Cr-6. Recommend **less than 1ug/L for Cr-6.***

Current norms in Ontario/Canada **much higher!**

Drinking Water

Total Cr = 50 ug/L

Cr-6 = 25 ug/L

Groundwater

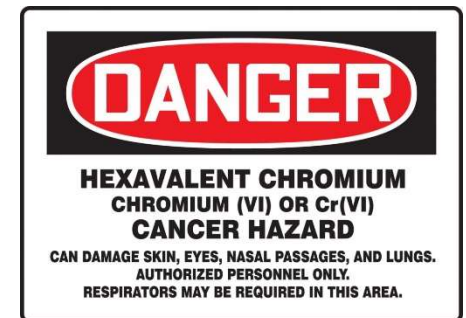
Total Cr = 11 ug/L

Cr-6 = 25 ug/L

Aquatic Life

Cr-6 = 1 ug/L

Cr-3 = 8.9 ug/L

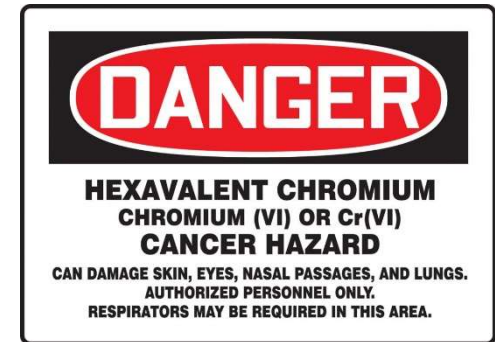


Effluent Discharge

Total Cr Aqueous = 2770 ug/L & Total Cr Leachate = 5000 ug/L

Sources: <http://cegg-rcqe.ccme.ca/en/index.html>, [Guidelines for Canadian Drinking Water Quality](#), [Ontario Drinking Water Quality Standards](#), [Hazardous Waste Quality Criteria](#), [Leachate Quality Criteria](#), [Waste Management Regulations](#)

Health Issues



Chromium VI (Cr-6)

- ❖ Highly toxic for humans, animals, living cells
- ❖ Carcinogenic Group 1 (e.g. asbestos, tobacco, radionuclides...)
- ❖ Cr-6 easily absorbed in cells, highest concentration in kidney and liver
- ❖ Known human health effects: Cancer, Respiratory problems, Irritation of digestion system, Damage to reproduction, Irritation to skin, etc.

Chromium III (Cr-3)

- ❖ Carcinogenic Group 3 "unclassified" (unknown, need more research)
- ❖ A 'nutrient' in small doses (good)
- ❖ Cr-3 usually leaves body in urine after 1 week, some may stay longer
- ❖ Recent studies show Cr-3 morphs into toxic Cr-6 in living cells
- ❖ Cr-3 maybe more toxic than Cr-6 for some organisms (e.g. algae)

Health Issues



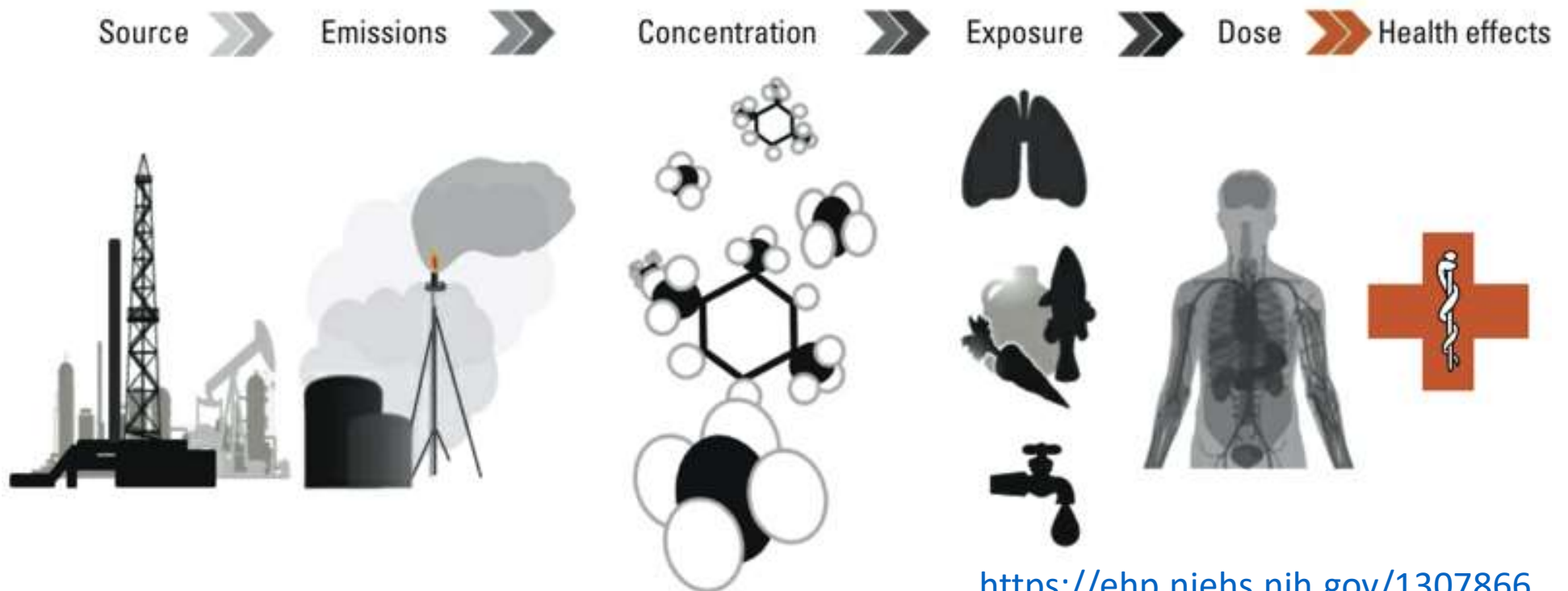
« This is the same toxic element in the movie Erin Brockovich. This movie was based on real life events. Hexavalent Chromium is the same cancer causing contaminant that was called the “safe” chromium, by PG&E and a judge ordered a settlement of \$333 million dollars in 1993. »

<https://www.sfgate.com/business/article/PG-E-to-Pay-333-Million-In-Pollution-Suit-3303933.php>

Health Issues

Exposures/Pathways

- ❖ Breathing (fine particulates)
- ❖ Drinking (dissolved in water)
- ❖ Ingestion (food or soil)
- ❖ Skin contact (dust/water)



<https://ehp.niehs.nih.gov/1307866>

Health & Environment - Current Norms



Drinking Water

Total Cr = 50 ug/L

Cr-6 = 25 ug/L

Groundwater

Total Cr = 11 ug/L

Cr-6 = 25 ug/L



Aquatic Life

Cr-6 = 1 ug/L

Cr-3 = 8.9 ug/L



Air Cr-6

TSP 24h = 0.0007 ug/m³

PM10 24h = 0.00035 ug/m³

PM10 Annual = 0.00007 ug/m³

TSP Annual = 0.00014 ug/m³



Soil

Ttl Cr 64 ug/g

Cr-6 0.4 ug/g



Discharge & Effluent

Total Cr Non-Aqueous Waste = 600 ug/L

Total Cr Aqueous Waste = 2770 ug/L

Total Cr Leachate = 5000 ug/L

Sources: <http://cegg-rcqe.ccme.ca/en/index.html>,
[Guidelines for Canadian Drinking Water Quality](#), [Ontario Drinking Water Quality Standards](#), [Canadian Sediment Quality Guidelines for the Protection of Aquatic Life](#), [Soil quality guidelines](#), [Ambient Air Quality Criteria - health](#), [Hazardous Waste Quality Criteria](#), [Leachate Quality Criteria](#), [Waste Management Regulations](#)

Ferrochrome Processing Pollution Sources

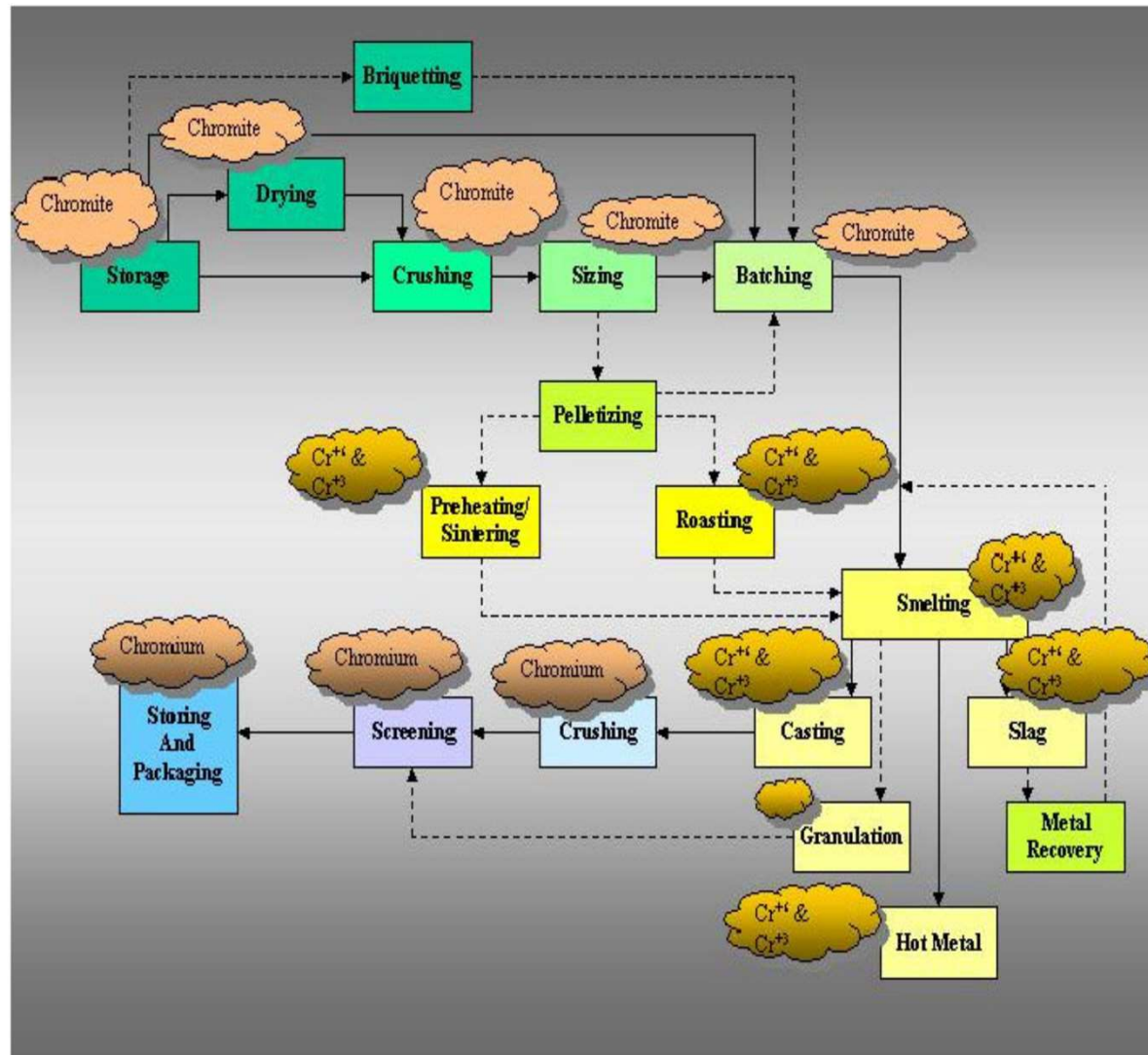


Figure 1. Simplified flowchart indicating potential locations of chromium emissions.

Burger, LW. 2004. [Hexavalent chromium air dispersion modelling in the South African ferrochromium industry](#). Proceedings: Tenth International Ferroalloys Congress, Pg. 806-817. See also Beukes JP, du Preez SP, van Zyl PG, Paktunc D, Fabritius T, Pääta M, Cramer M. 2017. [Review of Cr\(VI\) environmental practices in the chromite mining and smelting industry – Relevance to development of the Ring of Fire, Canada](#). Journal of Cleaner Production 165: 874-889.

- ❖ **Cr3 and Cr6 pollution occur in the many steps of mining & processing. Impossible to capture all pollution.**
- ❖ **Smelting is the biggest source of Cr6.** Most smelter dust is captured as hazardous waste and stored on land, in slime deposits behind dams.
- ❖ **Total Cr3 and Cr6 released to environment unknown. More studies needed.**
- ❖ **Other types of pollution must also be considered (e.g other metals).**

Ferrochrome Processing Pollution Sources

DuPreez et al 2017:

- ❖ *“Due to the deficiencies of the current treatment strategies, it is highly likely that sparingly water-soluble Cr-6 **compounds will leach from waste storage facilities (e.g. slimes dams) over time.** Therefore, it is critical that improved Cr-6 treatment strategies be formulated, which should be an important future perspective for FeCr producers and researchers alike.”*

Milačič et al. 2011

- ❖ Observes Cr-6 leachate pollution from slag waste products (<25 ug/L Cr-6)

Dhal et al 2013:

- ❖ Lots of effort to reduce Cr-6 to Cr-3 before releases to environment, **but that once Cr-3 is out in the environment, it can be oxidized to more toxic Cr-6 under various conditions.**
- ❖ Cr-3 and Cr-6 can change back and forth, when and how much is complicated, **so it makes it hard to predict** how much Cr-6 in environment.

What About the Finland FeCr Plant?



- ❖ **Integrated FeCr Smelter & Stainless Steel Factory**
- ❖ **Peninsula** surrounded by Bay of Bothnia (Baltic Sea, high saline water)
- ❖ **About 10km** downstream from Tornio



What About the Finland FeCr Plant?



Poykio et al. 2002:

- ❖ Show **Cr** pollution levels **4 to 13 times higher** than natural background
- ❖ Highest concentration **Cr** on soil = 200 ug/g (60 ug/g Canada Soil Guidelines)

No more independent studies since 2005... Why?

Poykio et al. 2005:

- ❖ Show pollution levels **in berries 4 to 33 times higher** than natural bckgd
- ❖ Chromium, Nickel, Vanadium, Cadmium pollution
- ❖ Highest concentrations **1.1 to 2.8km away**

Pöykio R. 2002. [Assessing industrial pollution by means of environmental samples in the Kemi-Tornio region](#). Academic Dissertation. University of Oulu (Department of Chemistry). Pöykio R, Maenpää A, Perämäki P, Niemela M, Valimäki I. 2005. [Heavy Metals \(Cr, Zn, Ni, V, Pb, Cd\) in Lingonberries \(*Vaccinium vitis-idaea* L.\) and Assessment of Human Exposure in Two Industrial Areas in the Kemi-Tornio Region, Northern Finland](#). Arch. Environ. Contam. Toxicol. 48: 338–343

What About the Finland FeCr Plant?

Each tonne of FeCr produces:

Air:

- CO₂: 0.64 tonne
- Dust: 102g
- Cr: 80g
- NO_x: 368g
- SO_x: 390g

Water:

- Cr: 3-5 g
- Cyanide: 0.3 à 1.5g
- Consumption: 5 to 15 tonnes

Land:

- Slag waste: 1.1 to 1.9 tonne (2-12% Cr)
- Hazardous waste: 30-40kg (up to 40% Cr)



Over 30+ years:

Thousands tonnes air pollution
Thousands tonnes water pollution
Millions of tonnes land pollution

Source: [http://www.liveablesudbury.org/chromite_smelter and](http://www.liveablesudbury.org/chromite_smelter_and)
https://drive.google.com/file/d/1b-gwME9ublNJ2Wxyw7EqAOvc0_wPKKBu/view

What About the Finland FeCr Plant?

DR. JARI TAUNO NATUNEN IN FINLAND



Expressed Concerns about health

- "I have a speculative idea about potential cancer effect in cancer maps around some tens of km from Tornio smelter by air fallout."
- While industry monitors workers and Finnish Occ. Health have norms and risks for workers, stricter norms should be in place for those living nearby.



More independent studies demanded on health & ecological effects !

What About the Finland FeCr Plant?

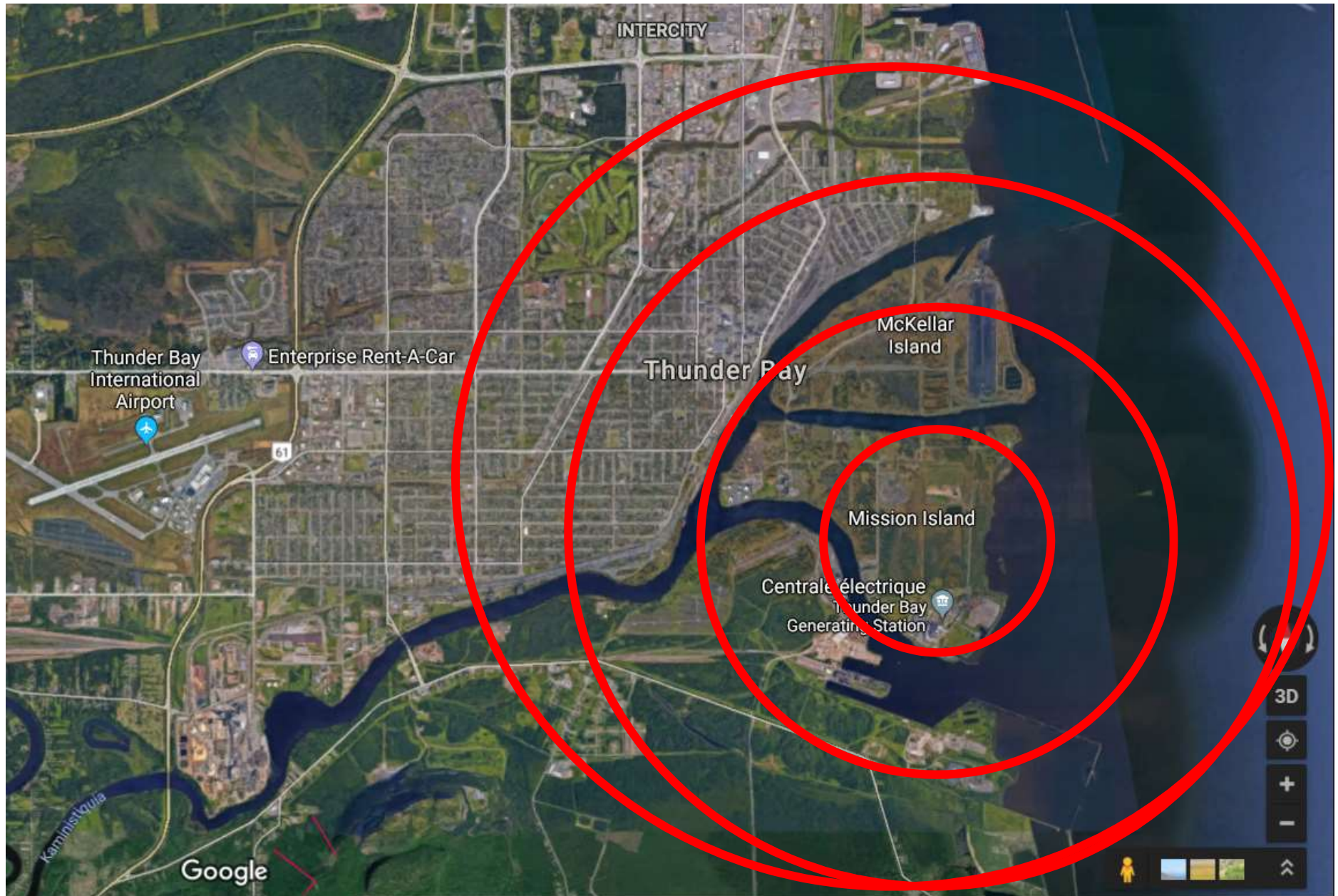
DR. NATUNEN ON ENVIRONMENTAL STANDARDS



Concerns about water & waste

- CrVI is a major threat to ground water. Limits are the lowest of any inorganic compound.
- the waste stone heaps in Kemi produce waters which are problematic in comparison with EU environmental quality standards and best norms of other countries
- Heat entering into the surrounding waters have unknown effects
- salt and sulfate levels as even temporarily layering of salts on fresh water lake bottoms may be harmful

What About Thunder Bay?



Environmental Reviews?

Ask for Joint
Ontario-Canada
EA Review now!

Ontario

- ❖ Only province in Canada not requiring EA for most private projects! Regular permitting process, unless Noront **voluntary subjects** its project to a full EA review, or if the public demands Minister/Cabinet to adopt **new regulation** to subject the project to an EA (s.3(c)EAA).

Auditor General of Ontario, 2016:

"The Act is 40 years old— and is, in fact, the oldest environmental assessment legislation in Canada — it falls short of achieving its intended purpose [...] Ontario's environmental assessment process needs to be modernized and aligned with best practices in Canada and internationally"

Canada

- ❖ Likely not, unless the Minister decides to require one if the public demands it and if the project may "cause adverse environmental effects or public concerns related to those effects may warrant the designation" (s.14(2) of CEAA 2012)

Conclusion

1. Pollution from chromite mining & ferrochrome processing is inevitable, it's a matter of controlling/minimizing the pollution. Cr-6 is highly toxic and Cr-3 can be too (many other pollutants)
2. No other precedent of FeCr plant in North America, no experience by industry & regulators in Ontario & Canada, norms not up-dated.
3. Current 'bidding contest' by Noront worrisome: Race to the Bottom?
4. Ferrochrome Plant in Finland far from "perfect," as portrayed so far...
5. Thunder Bay: Large population nearby, Water, Air, First Nations



If the environment is your top priority, *no go*. If you desperately need the economic development, demand for a full environmental review first.

Thank you

ugo@miningwatch.ca

514-708-0134

