May 24, 2012

Hazard Module Outline:

Objective: To determine what hazard concerns, if any, exist for the target chemical and potential alternatives.

At the lowest level of effort, this ~~The~~ evaluation process allows for ~~starts with~~ a simple comparison of the hazards of alternative(s) by collecting data from ~~to lists of chemicals from~~ authoritative[1] sources, ~~and~~ progresses, as desired by a specific user, to increasingly higher levels of effot ~~increases sequentially~~ until a validated hazard assessment is completed. The module includes ways to compare chemicals with each other and to select those that are less hazardous to human health and the environment compared to the target chemical under evaluation.

Needs bit more intro here as to the five levels and their meanings/thresholds, etc. e.g., something about each Level has increasing data requirements and the level of confidence increases substantially with each increasing level of effort.

The initial three (do you mean 1-2?) or all five levels of this module are adequate ~~at~~ to identify~~ing~~ chemicals that are known to be hazardous and are not considered viable alternatives to the chemical of concern.

Because the assessments ~~reviews~~ are based primarily upon authoritative data sources~~lists~~, other restricting information, or a subset of the full 18 endpoints, chemicals that fail evaluations at Levels 1 through 3 can be eliminated as inherently safer alternatives from the hazard perspective.

If a chemical does not appear on one of the initial authoritative lists in Levels 1-3, then further analysis is needed to identify if any concerns exist not documented in the authoritative lists and the other limited sources of information used in Levels 1 through 3. In order for a chemical to be identified as a truly safer alternative, a more detailed and comprehensive evaluation is needed as described in Levels 4 and 5.

The relative confidence that exists for each level can be approximated graphically. Graph 5 shows the relative confidence (%) one has in the hazard assessment based upon the data requirements in each level.

Graph 5: Comparison of L~~l~~evel of C~~c~~onfidence with I~~i~~dentifying I~~I~~nherently 'G~~g~~reen' or S~~s~~afer A~~a~~lternatives for each of the Levels in the Hazard Module

Comment [MG1]: This is confusing as written, and as written implies that a person will use all 5 levels.

If someone is going to do level 5, do they have to go through levels 1-4 as well?

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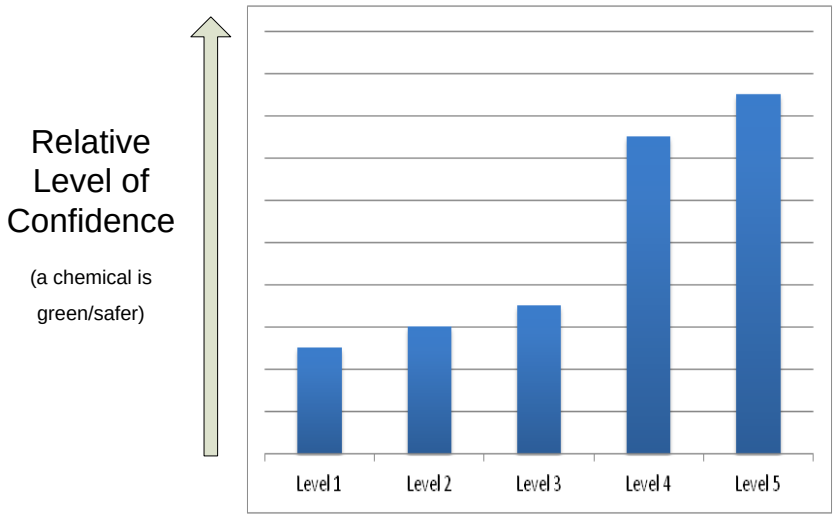
Comment [MG2]: What about the user who just wants to decide if a chemical is of concern (not comparing it to others).

e.g., we used qcat criteria for a marine coating additive (one chemical only) and based on a H rating for an endpoint, that was enough to have this customer avoid purchasing it.

Comment [MG3]: Unclear, also makes awkward sentence because I don't yet have a context of "other restricting info", or what you have in mind for subset of full 18 endpoints, nor what the full 18 endpoints are….

Comment [MG4]: Shouldn't this be graph 1?

[1] Authoritative means an independent, unbiased and typically government based organization with specialty experience and knowledge in a specific hazard trait. It may include screening lists from the same type of organizations.



No level in the module can provide 100% certainty that a chemical is truly a safer alternative to a chemical of concern based on inherent hazard as new data are always being developed and modeled data range in their level of certainty. However, each Level has increasing data requirements and the level of confidence increases substantially with each increasing level.

There is a major increase in confidence between Level 3 and Level 4. This is due to the increase both in the number of hazard endpoints reviewed and the amount of data required between the two levels. This graph is only meant as a representation of the issue.

A description of the steps to conduct for each of the levels is provided below.

Level 1: (List Translator)

A: Toxicity:

- Is the chemical on any of the authoritative sources having endpoints designated as #1 in Table X?
  - If YES:
    - Bin the chemicals found on these lists as an undesirable alternative.
  - If NO:
    - Consider chemical as a potential alternative.

If yes, Identify the toxicity concerns for the potential alternative and the authoritative list in which the chemical appears. A "yes" ~~This information~~ is sufficient justification for eliminating the chemical from the list of potential alternatives. It is insufficient to identify the chemical, however, as a truly safer alternative.

Insert flow chart for this level

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Level 2: (Extended List Translator)

A: Toxicity:

- Is the chemical on any of the authoritative sources having endpoints designated as #1 and #2 in Table X?
  - If YES:
    - Bin the chemicals found on these lists as an undesirable alternative.
  - If NO:
    - Consider chemical as a potential alternative.

Note any toxicity concerns for the potential alternative.

If yes, i~~I~~dentify the toxicity concerns for the potential alternative and the authoritative list in which the chemical appears. A "yes" ~~This information~~ is sufficient justification for eliminating the chemical from the list of potential alternatives. It is insufficient to identify the chemical, however, as a truly safer alternative.

No more flowcharts? Only for level 1?

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Level 3:

Level 3 expands upon the simple comparisons with authoritative lists conducted in Levels 1 and 2 and includes a series of authoritative sources and databases for more information on potential hazards associated with the chemical of interest. In addition, this is the first level that conducts a simplified data gap analysis that evaluates the quantity and quality of data gaps. This data gap analysis helps to identify the level of confidence with the decisions related to the chemical under evaluation. Although the number of data sources are more than Levels 1 and 2, ~~have been expanded,~~ Level 3is best at determining those chemicals that have identified hazards. Lack of data from these limited sources is still insufficient for determining truly safer alternatives.

Toxicity:

This level builds upon the authoritative lists used in Levels 1 and 2 and adds selected sources of information and databases from other authoritative sources. This technical information is intended for review by individuals with limited technical expertise and experience. In addition, Level 3 is the first to establish criteria to evaluate both the quality and quantity of data gaps in an evaluation. By determining the importance and quantity of data baps in the evaluation, the data gap analysis attempts to quantify the level of confidence in the decision reached.

1. **Grading of chemical based upon technical information:**
   - Is the chemical on any of the authoritative sources having endpoints designated as #1 and #2 in Table X? Some lists represent the presence or absence of a high level of concern. Other lists will offer data or information on levels of concern (such as LD50 or NOAEL) that can be compared against established criteria. Information on specific lists and how they can be interpreted ~~will be~~ is provided.
     - If YES:
       - Compare with criteria established by EPA's Design for the Environment Program (DfE) and adapted by Clean Production Action's GreenScreen™, enter the ranking results from very high to very low (where appropriate) in the template shown in Table 1a. An example of ~~what~~ a completed ~~filled out~~ template ~~might resemble~~ appears in Table 1b. Criteria ~~Information on how~~ to separate the information into different ranks is ~~can be~~ found in Appendix A.
       - Bin the chemicals found on these lists as undesirable alternatives.
     - If NO:
       - Continue evaluation.
         - Can information on toxicity for nine endpoints (C, M, R, D, E, AT, AA, P & B) from sources designated as #1, #2, or #3 in Table X be found in the following sources: ~~?~~
           - GHS listings (EU and other applicable countries)
           - ECOTOX database
           - EPA PBT Profiler
           - EU Risk Assessments
           - OECD-IUCLID datasheets
           - OECD-SIDS datasets
           - RTECS
           - TOXNET HSDB
         - If YES:
           - Compare with criteria established by EPA's Design for the Environment Program (DfE) and adapted by Clean Production Action's GreenScreen™, enter the ranking results from very high to very low (where appropriate) in the template

Comment [MG5]: If there is alack of data from these limited resources, then …

Not sure what you are telling the user to do….

Comment [MG6]: This is somewhat redundant from paragraph above. Could consolidate these 2.

Comment [MG7]: Link to criteria?

Comment [MG8]: Link to this?

Comment [MG9]: Need to define prior to this list

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Comment [MG10]: Links?

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shown in Table 1a. An example of what a filled out template might resemble appears in Table 1b. Criteria ~~Information on how to~~ to separate the data into different ranks ~~can be~~ is found in Appendix A.

- Continue evaluation.

- If NO:
  - Identify any blank hazard endpoint as a 'data gap' and place a 'DG' in the data summary table (using example format Table 1a).
  - Compare the results obtained and displayed in the template (Table 1a) with the grading criteria in Table 2. Assign the appropriate grade based upon this evaluation. Grades range from 'F' for chemicals to avoid through increase grades 'C', 'B' and 'A'. Table 2 identifies what criteria are required to assign each grade. As mentioned previously because the hazard endpoints and data sources are limited in level 3, confidence should only be placed upon chemicals assigned a grade 'F'.

    - Further review is needed to determine if the other chemicals are truly safer alternatives. Note: This is the first grade that will be assigned to the chemical. A second grade will be assigned based upon data gap analysis. The final grade will be a comparison of the two grades and the lower of the two will be selected as the final grade.

2. Data gap analysis and assigned grade based upon this analysis:

- Using the data[2] displayed in the template format (Table 1a, example shown in Table 1b), it is necessary to see if there are sufficient data gaps to affect the final grading of the chemical. The data gaps analysis only looks at the 9 endpoints being evaluated in this level, specifically C, M, R, D, E, AT, AA, P & B. The other endpoints in the table are assumed unknown (identified as a '?') for this analysis and are not included in the data gap review. Basically, the user is attempting to identify the level of confidence in the grade assigned. The more data lacking, the lower the level of confidence.

The ~~criteria~~ steps ~~used~~ for the data gap analysis are:

- Does the chemical meet Grade C requirements?
  - Is the chemical missing data for any of the following hazard endpoints: Mutagenicity/Genotoxicity, Acute Mammalian Toxicity, Persistence, Bioaccumulation or Acute Aquatic Toxicity?
    - If YES:
      - Assign the chemical a grade F_{DG}
      - Data gap analysis complete and assign final data gap grade.
    - If NO:
      - Continue analysis
      - Does the chemical have more than two data gaps?
        - If YES:
        - Assign the chemical a grade F_{DG}

[2] Data in this information means toxicity results used to rank toxicity concerns. Data can mean actual study results but can also include inclusion on specific lists, modeling results, professional judgment, etc., any information that can be used to rank the chemicals into level of concern.

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Comment [MG11]: If this follows the "If no" section, it should be indented. Otherwise, user will assume he does this bullet even if you get a "yes" on the first bullet.

Hopefully this makes sense. This should happen throughout entire doc. But I see that there are more and more if/then/statements, so pretty soon you'll be indenting to the right margin.

Anyway – as written, this may be very befuddling … I wonder if there is a better way to reflect the logic/progression here.

I'll stop worrying about this though, now that I understand how it's written.

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- Data gap analysis complete and assign final data gap grade.
- If NO:
  - Continue analysis

- If the chemical has only two data gaps, are the two gaps other than Endocrine Activity and either Carcinogenicity, Reproductive Toxicity or Developmental Toxicity?
  - If YES:
    - Meet Grade C data requirements
    - Determine if the chemical meets Grade B requirements. If yes,
    - ~~Does the chemical meet Grade B requirements?~~
      - Is the chemical missing two or more of the following hazard endpoints: Carcinogenicity, Reproductive Toxicity, Developmental Toxicity, Mutagenicity/Genotoxicity, Endocrine Activity or Acute Mammalian Toxicity?
        - If YES:
          - Assign the chemical a grade C_{DG}
          - Data gap analysis complete and assign final data gap grade.
        - If NO:
          - Continue analysis
    -
  - If NO:
    - Assign the chemical a grade F_{DG}
    - Data gap analysis complete and assign final data gap grade.

- ~~Does the chemical meet Grade B requirements?~~
  - ~~Is the chemical missing two or more of the following hazard endpoints: Carcinogenicity, Reproductive Toxicity, Developmental Toxicity, Mutagenicity/Genotoxicity, Endocrine Activity or Acute Mammalian Toxicity?~~
    - ~~If YES:~~
      - ~~Assign the chemical a grade C_{DG}~~
      - ~~Data gap analysis complete and assign final data gap grade.~~
    - ~~If NO:~~
      - ~~Continue analysis~~
  - If the chemical data for any endpoint other than Endocrine Activity?
    - If YES:
      - Assign the chemical a grade C_{DG}
      - Data gap analysis complete and assign final data gap grade.
    - If NO:
      - Continue analysis
  - Is the chemical is missing any of the remaining criteria, i. e. Persistence, Bioaccumulation or Acute Aquatic Toxicity?
    - If YES:
      - Assign the chemical a grade C_{DG}
      - Data gap analysis complete and assign final data gap grade.
    - If NO:
      - Meets grade B data requirements
      - Determine if the chemical meets Grade A data requirements.
- Does the chemical meet Grade A requirements?

Comment [MG12]: indent

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Comment [MG13]: this should move up under the if yes bullet above

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Comment [MG14]: this should move up under the if yes bullet above

- Is the chemical missing **one or more** of the hazard endpoints?
  - If YES:
    - Assign the chemical a grade B_{DG}
    - Data gap analysis complete and assign final data gap grade.
  - If NO:
    - Continue analysis
- Is the chemical missing any criteria other than Endocrine Activity?
  - If YES:
    - Assign the chemical a grade B_{DG}
    - Data gap analysis complete and assign final data gap grade.
  - If NO:
    - Data gap analysis complete.

3. Assigning final grade:

- Compare the grade obtained based upon available data with the grade assigned by the data gap analysis evaluation. The chemical is assigned the lower of the two grades.
  - Is the final grade an 'F'?
    - If YES:
      - Bin chemical as an undesirable alternative to toxic chemical being evaluated.
    - If NO:
      - Continue analysis
  - Is the final grade an 'F_{DG}'?
    - If YES:
      - Further evaluation is warranted to fill data gaps **or**
      - Bin the chemical as undesirable alternative
  - Is the final grade a 'C', 'C_{DG}' or above?
    - If YES:
      - Chemical is a potential safer alternative.
      - Determine if further evaluation is warranted.

Comment [MG15]: how do you determine this?

Insert flow chart for this level

Need all endpoint "acronyms" defined. Some will have NO IDEA what ST means. Also confusing to have group I and II, without definition.

Table 1a: Blank template used to display assessment results

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS	SnR	IrS	IrE	AA	CA	P	B	Rx	F
						Single	repeat*	single	repeat*										
						?[3]	?	?	?	?	?	?	?		?			?	?

[3] The '?' means data in these hazard endpoints are not reviewed at this level **unless** data was available from Level 1 and 2 sources. This information is not used in the data gap analysis.

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Table 1b: Example of what a template used to display assessment results might look like once complete…..

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS	SnR	IrS	IrE	AA	CA	P	B	Rx	F
						Single	repeat*	single	repeat*										
M	L	M	L	M	L	?	?	?	?	?	?	?	?	L	?	vH	M	?	?

Comment [MG16]: different shades of yellow/green etc. than below.

Ranking:

Need to define H, M, L, DG (are you using DG), vH, and grade F assignments above and below. And "T", vBT etc. in table below.

Table 2: Grading of chemical based upon data found and ranking assigned in previous steps.

Grade A	• Low P + Low T (AA, AT and all Human Health endpoints).
Grade B	• Moderate P; **or** • Moderate B; **or** • Moderate AA; **or** • Moderate AT **or** one or more Human Health endpoints.
Grade C	• Moderate P + Moderate B + Moderate T (AA, AT, or any Human Health endpoint); **or** • High P & High B; **or** • High P + Moderate T (AA, AT, **or** any Human Health endpoint); **or** • High B + Moderate T (AA, AT, or any Human Health endpoint); **or** • Very High T (AA or AT).
Grade F	• PBT = High P + High B + [Very High T (AA or AT) or High T (Human Health)]; **or** • vPvB = very High P + very High B; **or** • vPT = very High P + [very High T (AA or AT) **or** High T (Human Health)]; **or** • vBT = very High B + [very High T (AA or AT) **or** High T (Human Health)]; **or** • High T (Human Health criteria).

Comment [MG17]: What is "T"? many will not get this

Grade A	Few concerns, i.e. safer chemical	**Preferable**
Grade B	Slight concern	**Improvement possible**
Grade C	Moderate concern	**Use but search for safer**
Grade F	High concern	**Avoid**

Level 4:

Level 4 is the first hazard level that conducts a completed and detailed hazard assessment. The previous levels (1-3) were limited both in the number of hazard criteria evaluated and the data sources reviewed. They are geared more toward the user with limited technical experience and expertise. Level 4 evaluates the potential alternatives against all 18 hazard endpoints and requires the involvement of technical expertise in the fields of toxicology, chemistry and related fields applicable to the hazard criteria being evaluated. It is also the first Level to use sources like peer-reviewed scientific articles, documents and databases that require technical expertise to evaluate appropriately. This more detailed and comprehensive evaluate translates, however, into a much improved level of confidence in the identification of truly safer potential alternatives.

Like ~~the~~ Level 3, this level bins the chemicals into four groups ranging from 'avoid-chemical of concern' to 'Prefer-safer alternatives.' These bins are called 'benchmarks' and chemicals are placed into one of the four benchmarks based upon the level of concern identified for all 18 hazard endpoints. These benchmarks will be discussed more in subsequent information and the description of the four benchmarks can be found in Table 4.

Level 4 also includes a data gap analysis that has the same overall objective as the data gap analysis in Level 3. Because Level 4 looks at all 18 hazard endpoints, the data gap analysis is more complicated; however, it also attempts to quantify the level of confidence one has in hazard evaluation.

Beginning with

1. **Grading of chemical based upon technical information:**
   - Is the chemical on any of the authoritative sources having endpoints designated as #1 and #2 in Table X?
     - If YES:
       - Collect the information for comparison with subsequent evaluations.
       - Continue with evaluation.
     - If NO:
       - Continue evaluation.
   - Can information on the relative toxicity for any of the endpoints be found in the sources with endpoints designated as #3 in Table X?
     - If YES:
       - Collect the information for comparison with subsequent evaluations.
       - Continue with evaluation.
     - If NO:
       - Continue evaluation.
   - Can information on the relative toxicity for any of the endpoints be found in the following sources for the endpoints designated as #4 in Table X:
     - Sensitization for both skin and respiratory
     - Irritation/corrosion for both skin and eye
     - Flammability
     - Reactivity
       - If YES:
         - Collect the information for comparison with subsequent evaluations.
         - Continue with evaluation.
       - If NO:

        - Continue evaluation.
- Can information on the relative toxicity of any endpoint be found using the following resources?
    - Review of scientific literature and toxicological databases
    - Review of QSAR and analog information
    - Professional judgment
        - If YES:
            - Collect the information for comparison with subsequent evaluations.
            - Continue with evaluation.
        - If NO:
            - Continue evaluation.
- Have all information sources been exhausted and all data available gathered to derive rankings for the endpoints with available data?
    - If YES:
        - Compare with criteria established by EPA's Design for the Environment Program (DfE) and adapted by Clean Production Action's GreenScreen™, enter the ranking results from very high to very low (where appropriate) in the template shown in Table 1a. An example of what a filled out template might resemble appears in Table 1b. The GreenScreen™ hazard criteria are available from Clean Production Action at: http://www.cleanproduction.org/library/greenscreen-hazard-criteria-2012-03.pdf.
        - Continue evaluation.
    - If NO:
        - If not all data sources have been reviewed, continue to collect data and revisit.
        - If all data sources have been reviewed, identify any blank hazard endpoint as a 'data gap' and place a 'DG' in the data summary table (using example format Table 1a).
- Compare the results obtained and displayed using the template (Table 3a) with the benchmarking criteria in Table 4. Assign the appropriate benchmark based upon this evaluation.
- Retain this benchmark for comparison with the benchmark obtained during the subsequent data gap analysis.

2. Data gap analysis and assigning benchmark based upon this analysis:

- Using the data displayed in the template format (Table 1a), a review is necessary to determine if the quantity and quality of data gaps affect the final grading of the chemical. The following questions capture the data gap analysis process:
    - Does the chemical meet Benchmark 2 data requirements?
        - Are there more than two~~2~~ data gaps in the Group I Human Health Endpoints?
            - If YES:
                - Assign the chemical a benchmark of 'U' for 'unspecified'.
                - Data analysis complete.
                - Proceed to assigning a final benchmark
            - If NO:
                - Continue evaluation.
        - Are there two data gaps **and** are the data gaps anything other than Endocrine Activity and either Reproductive or Developmental Toxicity?
            - If YES:
                - Assign the chemical a benchmark of 'U' for 'unspecified'.
                - Data analysis complete.

- Proceed to assigning a final benchmark
- If NO:
  - Continue evaluation.

- Are there more than 3 data gaps in Group II Human Health Endpoints
  - If YES:
    - Assign the chemical a benchmark of 'U' for 'unspecified'.
    - Data analysis complete.
    - Proceed to assigning a final benchmark
  - If NO:
    - Continue evaluation.
- Are there three data gaps **and** do the data gaps consist of anything other than one gap in Skin or Respiratory sensitization, one gap in Skin or Eye Irritation/Corrosivity **and** one other unrestricted hazard endpoint?
  - If YES:
    - Assign the chemical a benchmark of 'U' for 'unspecified'.
    - Data analysis complete.
    - Proceed to assigning a final benchmark.
  - If NO:
    - Continue evaluation.
- Are data for both Acute and Chronic Aquatic toxicity missing?
  - If YES:
    - Assign the chemical a benchmark of 'U' for 'unspecified'.
    - Data analysis complete.
    - Proceed to assigning a final benchmark
  - If NO:
    - Continue evaluation.
- Are data for both Bioaccumulation and Persistence missing?
  - If YES:
    - Assign the chemical a benchmark of 'U' for 'unspecified'.
    - Data analysis complete.
    - Proceed to assigning a final benchmark
  - If NO:
    - Continue evaluation.
- Are data for both Flammability and Reactivity missing?
  - If YES:
    - Assign the chemical a benchmark of 'U' for 'unspecified'.
    - Data analysis complete.
    - Proceed to assigning a final benchmark
  - If NO:
    - Data meet the requirements of Benchmark 2.
    - Determine if the data meets the requirements of Benchmark 3.

- Does the chemical meet Benchmark 3 data requirements?
  - Is there more than 1 data gap in the Group I Human Health Endpoints?
    - If YES:
      - Assign the chemical a benchmark of 'BM 2_{DG}'.
      - Data analysis complete.

Comment [MG18]: What do you mean by unrestricted? How do we know which ones are unrestricted?

        - Proceed to assigning a final benchmark
    - If NO:
        - Continue evaluation.
- Is there a data gap for anything other than Endocrine Activity?
    - If YES:
        - Assign the chemical a benchmark of 'BM 2_{DG}' for 'unspecified.
        - Data analysis complete.
        - Proceed to assigning a final benchmark
    - If NO:
        - Continue evaluation.
- Are there more than 2 data gaps in Group II Human Health Endpoints
    - If YES:
        - Assign the chemical a benchmark of 'BM 2_{DG}' for 'unspecified.
        - Data analysis complete.
        - Proceed to assigning a final benchmark
    - If NO:
        - Continue evaluation.
- Are there two data gaps **and** do the data gaps consist of anything other than one gap in Skin or Respiratory sensitization **and** one other unrestricted hazard endpoint?
    - If YES:
        - Assign the chemical a benchmark of 'BM 2_{DG}'.
        - Data analysis complete.
        - Proceed to assigning a final benchmark.
    - If NO:
        - Continue evaluation.
- Are data for either Acute or Chronic Aquatic toxicity missing?
    - If YES:
        - Assign the chemical a Benchmark of 'BM 2_{DG}'.
        - Data analysis complete.
        - Proceed to assigning a final benchmark
    - If NO:
        - Continue evaluation.
- Are data for either Bioaccumulation or Persistence missing?
    - If YES:
        - Assign the chemical a benchmark of 'BM 2_{DG}'.
        - Data analysis complete.
        - Proceed to assigning a final benchmark
    - If NO:
        - Continue evaluation.
- Are data for either Flammability or Reactivity missing?
    - If YES:
        - Assign the chemical a benchmark of 'BM 2_{DG}'.
        - Data analysis complete.
        - Proceed to assigning a final benchmark
    - If NO:
        - Data meet the requirements of Benchmark 3.

- Determine if the data meets the requirements of Benchmark 4.
- Does the chemical meet Benchmark 4 requirements?
  - Are there any data gaps in any endpoint?
    - If YES:
      - Assign the chemical a benchmark of 'BM 3_{DG}'.
      - Data analysis complete.
      - Proceed to assigning a final benchmark
    - If NO:
      - Data meet the requirements of Benchmark 4.

3. Assigning final benchmark:

- This process produces two benchmarks. The first is based upon what benchmark is possible using available data. The second is the highest benchmark possible based upon the quantity and presence of specific data gaps. Select the lower of the two benchmarks and assign it to the specific chemical.

Table 3a: Blank template used to display assessment results

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS	SnR	IrS	IrE	AA	CA	P	B	Rx	F
						Single	repeat*	single	repeat*										

Table 3b: Example of what a template used to display assessment results might look like once complete…..

Group I Human					Group II and II* Human									Ecotox		Fate		Physical	
C	M	R	D	E	AT	ST		N		SnS	SnR	IrS	IrE	AA	CA	P	B	Rx	F
						single	repeat*	single	repeat*										
M	L	M	L	M	L	L	L	H	H	L	DG	L	L	L	L	vH	M	L	L

Table 4: Benchmarking criteria using data displayed in Template 1a

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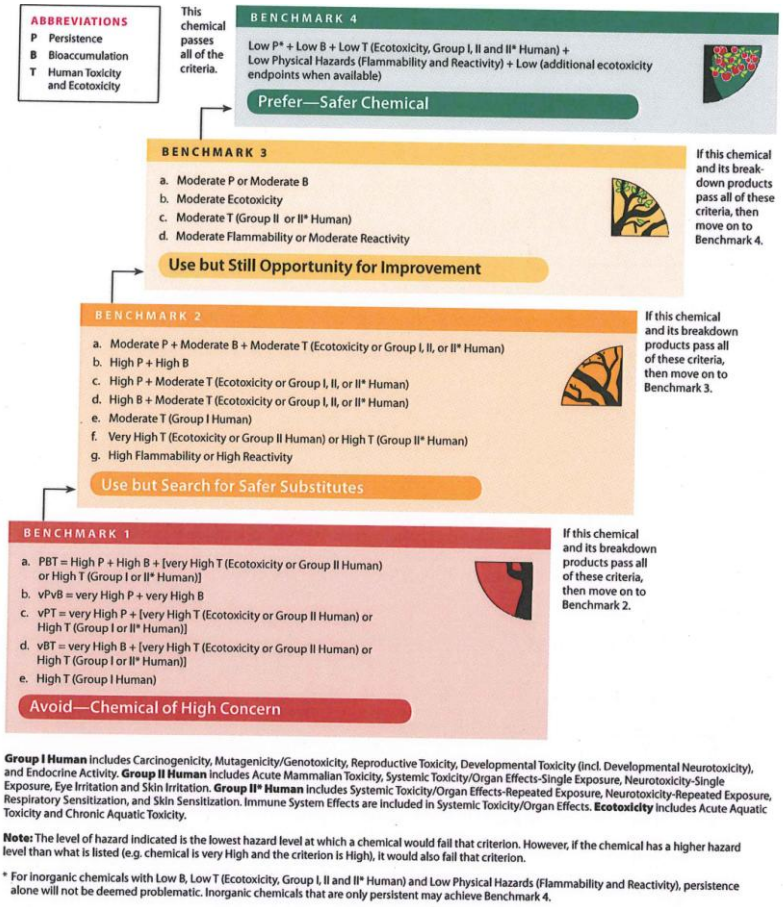

Benchmark 4	Few concerns, i.e. safer chemical	**Preferable**
Benchmark 3	Slight concern	**Improvement possible**
Benchmark 2	Moderate concern	**Use but search for safer**
Benchmark 1	High concern	**Avoid**

Insert flow chart for this level

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Level 5:

A: Toxicity:

- **Everything done in Level 4 and**
  - Compare with full suite of environmental hazard endpoints developed by California EPA Office of Environmental Health Hazard Assessment (OEHHA)[4]
  - Fill~~ing~~ in any data gaps by:
    - Use of chemical categories and/or structural analogs
    - Quantitative Structure Activity Relationship (QSAR[5]) determination by experts in the field
    - Conducting laboratory studies using methodologies approved by authoritative agencies such as the Organization for Economic Cooperation and Development (OECD), the US Environmental Protection Agency (EPA), the European Chemicals Agency (ECHA), the European Union chemical legislation known as the Registration, Evaluation and Authorisation of Chemicals (REACH), etc.
  - Subjecting analysis to peer review and validation

Note any toxicity concerns for the potential alternative.

Comment [MG19]: Where. And wouldn't this 'naturally' emerge from the above work?

Insert flow chart for this level

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[4] Information on the OEHHA criteria can be found at: http://www.oehha.ca.gov/multimedia/green/gc011912.html.

[5] QSAR are the results of computer modeling to estimate the potential toxicity of a chemical based upon a comparison of similar traits found in other toxic chemicals.

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Final Review:

Now that the assessment is complete, it is important to evaluate the work done to make sure that there is sufficient confidence in the results to meet the needs of the alternatives assessment. In order to evaluate the results of the hazard evaluation, the following questions will help to determine if additional work is needed.

- Has all of the required information for the Level selected been evaluated?
  - Have all the data sources been reviewed?
    - If YES:
      - Proceed with the Final Review.
    - If NO:
      - Return to the Level selected and review the remaining data sources.

  - Has a comparison been made between the data found and the criteria established by EPA's Design for the Environment Program and adapted by Clean Production Action's GreenScreen™?
    - If YES:
      - Proceed with the Final Review.
    - If NO:
      - Return to the Level selected and make the comparisons to identify the level of concern associated with the data found for each applicable hazard endpoint.

- Have you conducted an appropriate data gap analysis for the Level selected?
  - If YES:
    - Proceed with the Final Review.
  - If NO:
    - Return to the Level selected and conduct the required data gap analysis.

- Does the level selected require you to assign either a Grade or Benchmark, as appropriate.
  - Have you assigned either a Grade or Benchmark as appropriate for the Level selected?
    - If YES:
      - Proceed with the Final Review.
    - If NO:
      - Return to the Level selected and conduct the required data gap analysis.

- Are there any other issues that remain unresolved?
  - If YES:
    - Resolve the outstanding issues and ask the question again.
  - If NO:
    - Hazard assessment is complete for the chemical of interest.
    - Record the final conclusion for the chemical. The chemical fall into one of the following categories:
      a) Chemical appears on an authoritative list and therefore is not viable as a safer alternative (Levels 1 & 2).
      b) A simplified review has indicated the chemical has substantial concerns and it not a viable alternative to the chemical of concern (Level 3).

Comment [MG20]: Does this final review apply to all levels? If so, maybe at the end of the level 1 logic, you write, "proceed to the Final Review" steps. (ditto for other levels)

And explain here, that this final review applies to all levels. As read here, one may think it only applies to level 5.

c) A detailed review has placed the chemical into one of four benchmarks ranging from 'Avoid' to 'Preferable'. Details on the four benchmarks are found in Table 4. The chemical can be compared with other chemicals subjected to the same process. (Level ?)

d) The most comprehensive review possible has been conducted and validated by peer reviewers. This information allows the chemical to have the highest degree of confidence possible in the benchmark in which the chemical has been placed. The benchmarks range from 'Avoid' to 'Preferable'. More details on the benchmarks and what they mean can be found in Table 4. (Level 5)

Chemical comparison: (Level 4 and 5)

Comment [MG21]: This is not a 'directive", e.g., it could be some nice/extra info for the user to accept to undertake or not.

When should this comparison be done? (whenever one is looking at more than one chemical?)

Finally, for Level 4 or 5 evaluations, make c~~C~~hemical benchmark comparisons ~~can be made for chemicals that have received Level 4 or above evaluations.~~ This does not apply to ~~is because~~ Levels 1 through 3 because a ~~conduct a~~ limited review of the data and hazard endpoints was conducted. ~~available.~~ Qualitative comparisons can be made for chemical evaluated based on Levels 1-3, however, chemicals undergoing a Level 4 or 5 assessment can be grouped into one of four potential benchmarks, as shown in Table 5. It is important to include the chemical of concern in the evaluation so it is clear that a comparison is been between this chemical and potential alternatives.

Table 5: Grouping of alternatives

Chemical	CAS #	Benchmark
Chemical 10	1020304-00-1	1
Chemical 23	1020304-00-2	1
Chemical 30	1020304-00-3	1
Chemical 44	1020304-00-4	2
Chemical 25	1020304-00-5	2
Chemical 16	1020304-00-6	2
Chemical 17	1020304-00-7	2
Chemical 8	1020304-00-8	3
Chemical 19	1020304-00-9	3
Chemical 40	1020304-01-0	3
Chemical 11	1020304-01-1	3
Chemical 12	1020304-01-2	3
Chemical 33	1020304-01-3	4
Chemical 24	1020304-01-4	4
Chemical 5	1020304-01-5	4
Chemical 26	1020304-01-6	4
Chemical 27	1020304-01-7	4
Chemical 18	1020304-01-8	4
Chemical 99	1020304-01-9	4

The hazards associated with the alternatives have now been compared with the chemical of concern. For the purposes of the hazard module, the less toxic alternatives have been identified and can be selected for further evaluation. For example, the two chemicals identified as 'Preferred' (i. e. 'green') in ~~the~~ Table 5 above, would now be subjected to other modules to determine if there are any other issues that prevent the chemicals from being a viable alternative. It is possible that a chemical is too costly or the exposure potential would be substantially increased if it were used in place of the toxic chemical. These types of concerns or other trade-offs might reject the 'green' chemicals as a viable alternative. A similar comparison could then be done for the next benchmark chemicals, and so forth, until a chemical has been identified that has the lowest feasible hazard while meeting all module concerns. It also requires the user to identify why less hazardous chemicals are rejected and emphasizes the need for continual review and improvement.

Comment [MG22]: Are these the only 2 circumstances that might cause rejection?

Comment [MG23]: What are "module concerns"?

Comment [MG24]: How does it emphasize this? This is sort of a "hope" that people will come away with this principle after conducting an assessment, but doesn't necessarily directly emphasize the need for it.

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Table X:

Define 1, 2, 3, and 4

List	C	M	R	D	PBT	P	B	E	AA	CA	OE	SnS	SnR	IrS	IrE
AOEC Asthmagens													2		
CA Prop 65	1		1	1											
Canadian DSL PB_iT					1										
Canadian DSL vB_iT							1								
Canadian DSL vP_iT						1									
Endo. Disr. Exch.-TEDX								2							
EPA ECOTOX					3				3	4	4				
EPA IRIS	1														
EPA NWMP					1										
EPA PBT					1										
EPA TRI					1										
ESIS-RAs	3	3	3	3	3	3	3		4	4	4	4	4	4	4
OECD-IUCLID	3	3	3	3	3	3	3		4	4	4	4	4	4	4
OECD-SIDS datasets	3	3	3	3	3	3	3		4	4	4	4	4	4	4
EU ED-Cat. 1								2							
GHS[6]	2	2	2	2	2				4	4	4	4	4	4	4
EU PBT					1										
EU SVHC	1	1	1	1	1										
German Fed. Env. Ag.					2										
Grandjean & Landigran			2												
IARC	1														
NTP Report on Carc.	1														
NTP repro. toxics			1												
OR Pers. Priority Poll.					1										
OSPAR EDs								2							
OSPAR PBT					1										
EPA PBT Profiler				3	3										
RTECS	3	3	3	3											
Stockholm POP					1										
TOXNET HSDB	3	3	3		3	4	4		3	4	4	4	4	4	4
WA PBT					1										
WHMIS					2										

[6] GHS Information is available from the EU (CLP), Australia, Korea, Japan, among others

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Acronyms:

AA	=	Acute Aquatic toxicity
AOEC Asthmagens	=	Association of Occupational and Environmental Clinic list of chemicals causing asthma
AT	=	Acute toxicity
Australian GHS	=	Australian Global Harmonization System database
C	=	Carcinogenicity
CA	=	Chronic Aquatic toxicity
CA Prop 65	=	California Proposition 65
Canadian DSL PB_iT	=	Canadian Domestic Substance list of PB_iT list
Canadian DSL vB_iT	=	Canadian Domestic Substance list of very bioaccumulative and inherently toxic chemical list
Canadian DSL vP_iT	=	Canadian Domestic Substance list of very persistent and inherently toxic list of chemicals
D	=	Developmental toxicity
E	=	Endocrine activity
ED Exchange-TEDX	=	
EPA ECOTOX	=	EPA Ecotoxicity database
EPA IRIS	=	EPA Integrated Risk Information System chemical list
EPA NWMP	=	EPA National Waste Minimization Program chemical list
EPA PBT	=	EPA PBT chemical list
EPA PBT Profiler	=	EPA PBT modeling database
EPA TRI	=	EPA Toxics Release Inventory chemical list
ESIS	=	European chemical Substances Information System
ESIS-RAs	=	ESIS Risk Assessments[7]
EU	=	European Union
EU CLP/GHS	=	EU Classification and Labeling Programme/Global Harmonisation System database[2]
EU ED-Cat. 1	=	EU Endocrine Disruptor Screening list-category 1
EU PBT	=	EU PBT chemical list[2]
EU SVHC	=	EU Substances of Very High Concern chemical list
F	=	Flammability
German Fed. Env. Ag.	=	
GHS	=	Global Harmonisation System of Classifying and Labeling Chemicals
Grandjean & Landigran	=	Neurodevelopmental toxics list published in the Lancet by authors Grandjean & Landrigan
H	=	High level of concern
IARC	=	International Agency for Research on Cancer
IrE	=	Irritation-Eye
IrS	=	Irritation-Skin
Japan GHS	=	Japanese Global Harmonisation System database
Korean GHS	=	Korean Global Harmonisation System database
L	=	Low level of concern
M	=	Moderate level of concern
M	=	Mutagenicity/genotoxicity
N	=	Neurotoxicity
NTP RoC	=	National Toxicology Program Report on Carcinogens
NTP repro. toxics	=	National Toxicology Program Reproductive toxic chemical list
OE	=	Other Environmental toxicity
OECD	=	Organisation for Economic Cooperation and Development
OECD-IUCLID	=	OECD International Uniform Chemical Information Database[2]
OECD-SIDS	=	OECD Safety Information Datasheets[2]
OEHHA	=	Office of Environmental Human Hazard Assessment of the California EPA
OR Pers. Priority Poll.	=	Oregon Persistent Priority Pollutant chemical list
OSPAR EDs	=	Oslo-Paris Commission Endocrine Disruptor chemical list

[7] This information is found in the ESIS database either as a separate database or as a link to the existing documentation.

OSPAR PBT	=	Oslo-Paris Commission PBT chemical list
PB_iT	=	Persistent, Bioaccumulative and inherently Toxic chemical
PBT	=	Persistent, Bioaccumulative and Toxic chemical
QSAR	=	Quality Structure Activity Relationships
R	=	Reproductivity
REACH	=	Registration, Evaluation and Authorisation of CHemicals, Chemical Legislation in the EU
Repeat	=	Repeat dose study
RTECS	=	Registry of Toxic Effects of Chemical Substances database
Rx	=	Reactivity
Single	=	Single dose study
SnR	=	Sensitization-Respiratory
SnS	=	Sensitization-Skin
ST	=	Systemic toxicity
Stockholm POP	=	Stockholm Persistent Organic Pollutant chemical list
T	=	??? from a benchmark table 2 above
TOXNET HSDB	=	Toxicology Data Network Hazardous Substances Database
vH	=	Very high level of concern
vL	=	Very low level of concern
vBT	=	??? from a benchmark table 2above
vPvB etc etc.	=	??? from a benchmark table 2 above
WA PBT	=	Washington PBT chemical list
WHMIS	=	Workplace Hazardous Materials Information System chemical list

Appendix A: Chemical Ranking Criteria

Human Health: Carcinogenicity

High (H)	Moderate (M)	Low (L)
NTP RoC Known to be human carcinogen Reasonably anticipated to be human carcinogen California Prop 65 Known to the state to cause cancer EU SVHC Reason for inclusion: carcinogen		Adequate data available with negative results. DfE General Screen Criteria
NIOSH/OSHA Occupational Carcinogen	OSHA Carcinogen Identified as a potential carcinogen by OSHA	
IARC Group 1: Known carcinogen Group 2a: Probable carcinogen	IARC Group 2b: Possibly carcinogenic to humans Group 3: Suggestive evidence of carcinogenicity	IARC Group 4: Probably not carcinogenic to humans
EPA IRIS 1986 Group A: Human carcinogen Group B1: Probable carcinogen Group B2: Probable carcinogen EPA IRIS 1996 Known/likely carcinogen IRIS 1999 or 2005 Carcinogenic to humans Likely to be carcinogenic	IRIS 1986 Group C: Possible human carcinogen IRIS 1999 or 2005 Criteria Suggestive evidence of carcinogenicity	IRIS 1986 Group E: Evidence of non-carcinogenicity IRIS 1999 or 2005 Criteria Not likely to be carcinogenic to humans
European Union CMR Category 1: Known carcinogen Category 2: Should be considered carcinogen	European Commission CMR Category 3: Possibly carcinogenic to humans	
ISSCAN Value Ranking = 3, Carcinogenic	ISSCAN Value Ranking = 2, Undetermined or equivocal	ISSCAN Value Ranking = 1, Non-carcinogenic
GHS/EU CMR Category 1A: Known to be carcinogenic Category 1B: Presumed to be carcinogenic	GHS/EU CMR Category 2: Suspected carcinogen	GHS NO category
Risk Phrases R45: May cause cancer	Risk Phrases R40: Limited evidence of carcinogenicity	

R49: May cause cancer by inhalation		
Hazard Phrases H350: May cause cancer H350i: May cause cancer by inhalation	Hazard Phrases H351-Suspected of causing cancer	Hazard Phrases NO hazard phrase
EU RA, IUCLID Datasheet or UNEP SIDS Strong evidence of carcinogenicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of carcinogenicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of NO carcinogenicity

Human Health: Mutagenicity/Genotoxicity

High (H)	Moderate (M)	Low (L)
EU SVHC Reason for inclusion: Mutagenicity/Genotoxicity		DfE General Screen Criteria
GHS Category 1A: Known to be mutagenic/genotoxic Category 1B: Regarded as if they are mutagenic/genotoxic	GHS Category 2: Suspected mutagenic/genotoxic	GHS NO category
EU CMR Category1: Known to be mutagenic/genotoxic Category 2: Presumed to be mutagenic/genotoxic Mutagen 1A: Known to be mutagenic/genotoxic Mutagen 1B: Presumed to be mutagenic/genotoxic	EU CMR Category3: Suspected to be mutagenic/genotoxic Mutagen 2: Suspected to be mutagenic/genotoxic	
ISSCAN SAL Value Ranking = 3, Mutagenic	ISSCAN Value Ranking = 2, Undetermined or equivocal	ISSCAN Value Ranking = 1, Non-mutagenic
Risk Phrases R46: May cause heritable genetic damage	Risk Phrases R68: Strong evidence of heritable genetic damage	Risk Phrases NO risk phrase
Hazard Phrases H340-May cause genetic defects	Hazard Phrases H341-Suspected of causing genetic defects	Hazard Phrases NO hazard phrase
EU RA, IUCLID Datasheet or UNEP SIDS Strong evidence of mutagenicity/genotoxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of mutagenicity/genotoxicity	EU RA, IUCLID Datasheet or UNEP SIDS Adequate data available and negative studies.

Human Health: Reproductive Toxicity

High (H)	Moderate (M)	Low (L)
California Prop 65 Known to the state to cause reproductive effects-male Known to the state to cause reproductive effects-female ECHA Listing[8] SVHC- Toxic for reproduction EU CMR Repro 1A Repro 1B		DfE General Screen Criteria
NTP-OHAaT Clear evidence of Adverse Effects-Reproductive Toxicity	NTP-OHAaT Limited or some evidence of Adverse Effects-Repro Tox.	NTP-OHAaT Clear evidence of NO Adverse Effects-Repro. Tox.
GHS Category 1A: Known reproductive toxicant Category 1B: Presumed reproductive toxicant	GHS Category 2: Suspected reproductive toxicant, or has effect on lactation	GHS NO category
Risk Phrases R60: May impair fertility	Risk Phrases R62: Possible risk of impaired fertility	Risk Phrases NO risk phrase
Hazard Phrases H360F: May damage fertility H360FD: May damage fertility or the unborn child H360Fd: may damage fertility. Suspected of damaging unborn child	Hazard Phrases H360 Df-May damage unborn. Suspected of damaging fert. H361f-Suspected of damaging fertility H361fd-Suspected of damaging fertility & unborn child	Hazard Phrases NO hazard phrase
EPA Characterization Criteria: LOAEL, TD_{lo} or TC_{lo} Values Oral < 50 mg/kg-bw/d Dermal < 100 mg/kg-bw/d Inhalation (vapor) < 1.0 mg/L/d Inhalation (dust/mist/fume) < 0.1 mg/L/d Inhalation (gas) < 50 ppm/d	EPA Characterization Criteria: LOAEL, TD_{lo} or TC_{lo} Values Oral ≥ 50 but < 250 mg/kg-bw/d Dermal ≥ 100but < 500 mg/kg-bw/d Inhalation (vapor) ≥ 1.0 but < 2.5 mg/L/d Inhalation (dust/mist/fume) ≥ 0.1 but < 0.5 mg/L/d Inhalation (gas) ≥ 50 but < 250 ppm/d	EPA Characterization Criteria: LOAEL, TD_{lo} or TC_{lo} Values Oral ≥ 250mg/kg-bw/d Dermal ≥ 500 mg/kg-bw/d Inhalation (vapor) ≥ 2.5 mg/L/d Inhalation (dust/mist/fume) ≥ 0.5 mg/L/d Inhalation (gas) ≥ 250 ppm/d
EU RA, IUCLID Datasheet or UNEP SIDS Strong evidence of repro/developmental toxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of repro/developmental toxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of NO repro/developmental toxicity

[8] ECHA listings and EU CMRs include both reproduction and developmental effects in one grouping under a broad definition of 'Reproductive toxicity'. For the purposes of QCAT, the distinction between whether these are listings are actually due to reproductive or developmental effects is left for a more detailed assessment such as the GS™. The QCAT will assume that all of the effects are grouped here.

Human Health: Developmental (including developmental neurotoxicity)

High (H)	Moderate (M)	Low (L)
California Prop 65 Known to the state to cause reproductive effects-developmental Grandjean & Landrigan list Presence on list		DfE General Screen Criteria
NTP-OHAaT Clear evidence of Adverse Effects-Developmental	NTP-OHAaT Limited or some evidence of Adverse Effects-Dev.	NTP-OHAaT Clear evidence of NO Adverse Effects- Developmental Limited or some of NO Adverse Effects-Developmental
GHS Category 1A: Known developmental toxicant Category 1B: Presumed developmental toxicant	GHS Category 2: Suspected developmental toxicant, or has effect on lactation	GHS NO category
Risk Phrases R61: May cause harm to unborn child R64: May cause harm to breast-fed babies	Risk Phrases R63: Possible risk of harm to unborn child	Risk Phrases NO risk phrase
Hazard Phrases H360D: May damage the unborn child H360FD: May damage fertility or the unborn child HD360Df: May damage unborn child or suspected of damaging fertility H362: May cause harm to breast-fed children	Hazard Phrases H360Fd-Suspected of impacting fertility or unborn child H361d-Suspected of damaging fertility or unborn child H361fd-Suspected of damaging fertility & unborn child	Hazard Phrases NO hazard phrase
EU RA, IUCLID Datasheet or UNEP SIDS Strong evidence of repro/developmental toxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of repro/developmental toxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of NO repro/developmental toxicity

Human Health: Endocrine Activity

High (H)	Moderate (M)	Low (L)
OSPAR List of Endocrine Disruptors EU SVHC Reason for inclusion: Endocrine Activity		Meets DfE General Screen Criteria for each endpoint related to an endocrine system mediated effect (e. g., carcinogenicity, reproductive/developmental tox., repeated dose tox.)
European Commission Category 1: Known to impair fertility or cause dev. toxicity	European Commission Category 2: Impair fertility or causes dev. tox. Category 3b: Some evidence of endocrine activity	European Commission Category 3a: Clear evidence of NO endocrine activity
EU RA, IUCLID Datasheet or UNEP SIDS Evidence of endocrine activity and related human health effect	EU RA, IUCLID Datasheet or UNEP SIDS Some evidence of endocrine activity and effects	EU RA, IUCLID Datasheet or UNEP SIDS Adequate data available as evidence of NO endocrine activity

Human Health: Acute Mammalian Toxicity

Very High (vH)	High (H)	Moderate (M)	Low (L)
NO authoritative lists available	EPA National Waste Min. Program, Priority Chemicals Presence on the list		NO authoritative lists available DfE General Screen Criteria
GHS Category 1 Category 2	GHS Category 3	GHS Category 4	GHS Category 5
Risk Phrases R26-Very toxic via inhalation R27-Very toxic via skin R28-Very toxic if swallowed	Risk Phrases R23-Toxic via inhalation R24-Toxic via skin R25-Toxic if swallowed	Risk Phrases R20- Harmful via inhalation R21- Harmful via skin R22- Harmful if swallowed	Risk Phrases NO Risk Phrase
Hazard Phrases H300-Fatal if swallowed H310-Fatal in contact with skin H330-Fatal if inhaled	Hazard Phrases H301-Toxic if swallowed H311-Toxic in contact with skin H331-Toxic if inhaled	Hazard Phrases H302-Harmful if swallowed H312-Harmful in contact with skin H332-Harmful if inhaled	Hazard Phrases H303-May be harmful if swallowed H313-May be harmful in contact with skin H333-May be harmful if inhaled
Technical Criteria Oral $LD_{50} \leq 50$ mg/kg bw Dermal $LD_{50} \leq 200$ mg/kg bw Inhalation (g) $LC_{50} \leq 500$ ppm Inhalation (v) $LC_{50} \leq 2.0$ mg/l Inhalation (dust, mist) $LC_{50} \leq 0.5$ mg/l	Technical Criteria Oral $LD_{50} > 50$ but ≤ 300 mg/kg bw Dermal $LD_{50} > 200$ but $\leq 1,000$ mg/kg bw Inhalation (g) $LC_{50} > 500$ but $\leq 2,500$ ppm Inhalation (v) $LC_{50} > 2.0$ but ≤ 10.0 mg/l Inhalation (dm) $LC_{50} > 0.5$ but ≤ 1.0 mg/l	Technical Criteria Oral $LD_{50} > 300$ but $\leq 2,000$ mg/kg bw Dermal $LD_{50} > 1,000$ but $\leq 2,000$ mg/kg bw Inhalation (g) $LC_{50} > 2,500$ but $\leq 20,000$ ppm Inhalation (v) $LC_{50} > 10.0$ but ≤ 20.0 mg/l Inhalation (dm) $LC_{50} > 1.0$ but ≤ 5.0 mg/l	Technical Criteria Oral $LD_{50} > 2,000$ mg/kg bw Dermal $LD_{50} > 2,000$ mg/kg bw Inhalation (g) $LC_{50} > 20,000$ ppm Inhalation (v) $LC_{50} > 20.0$ mg/l Inhalation (dm) $LC_{50} > 5.0$ mg/l
	EU RA, IUCLID Datasheet or UNEP SIDS Strong evidence of acute mammalian toxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of acute mammalian toxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of NO acute mammalian toxicity

Environmental Health: Acute Aquatic Toxicity

Very High (vH)	High (H)	Moderate (M)	Low (L)
Canadian DSL Chemicals Identified as Inherently Toxic to Aquatic Organisms, presence on list			Canadian DSL Identified as not meeting inherently toxic criteria
GHS Category 1: Very toxic to aquatic life	GHS Category 2: Toxic to aquatic life	GHS Category 3: Harmful to aquatic life	GHS NO criteria
Risk Phrases R50-Very toxic to aquatic organisms	Risk Phrases R51-Toxic to aquatic organisms	Risk Phrases R52-Harmful to aquatic organisms	Risk Phrases NO risk phrase
Hazard Phrases H400: Very toxic to aquatic life	Hazard Phrases H401: Toxic to aquatic life	Hazard Phrases H402: Harmful to aquatic life	Hazard Phrases NO hazard phrase
Technical Criteria 96 hr LC_{50} (f[9]) ≤ 1 mg/l 48 hr EC_{50} (c[10]) ≤ 1 mg/l 72 or 96 ErC_{50} (a[11]) ≤ 1 mg/l	Technical Criteria 96 hr LC_{50} (f) >1 but ≤ 10 mg/l 48 hr EC_{50} (c) > 1 but ≤ 10 mg/l 72 or 96 ErC_{50} (a) > 1 but ≤ 10 mg/l	Technical Criteria 96 hr LC_{50} (f) > 10 but ≤ 100 mg/l 48 hr EC_{50} (c) > 10 but ≤ 100 mg/l 72 or 96 ErC_{50} (a) > 10 but ≤ 100 mg/l	Technical Criteria 96 hr LC_{50} (f) > 100 mg/l 48 hr EC_{50} (c) > 100 mg/l 72 or 96 ErC_{50} (a) > 100 mg/l
	EU RA, IUCLID Datasheet or UNEP SIDS Strong evidence of acute aquatic toxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of acute aquatic toxicity	EU RA, IUCLID Datasheet or UNEP SIDS Indication of NO acute aquatic toxicity

[9] f = fish
[10] c = crustacea
[11] a = algae or other aquatic plants

Environmental Fate: Persistence

Very High (vH)	High (H)	Moderate (M)	Low (L)	Very Low (vL)
Stockholm POPs Presence on list EPA TRI PBT List Presence on list EPA PBT List Presence on list EU PBT List Presence on list WA State PBT List Presence on list EU vPvB List Presence on list Oregon P3 List Presence on list ECHA Listing SVHC- vPvB or PBT	Canadian DSL PBiT List Presence on list Canadian DSL PT List Presence on list OSPAR Chemicals of Possible Concern PBT List Presence on list OSPAR Chemicals for Priority Action List Presence on list		Meets GHS Definition for Rapid Degradability	Meets 10-day window as measured in a ready biodegradation
Technical Criteria Half-life (ss[12]) > 180 days Half-life (w[13]) > 60 days Half-life (a[14]) > 5 days	Technical Criteria Half-life (ss) > 60 to 180 days Half-life (w) > 40 to 60 days Half-life (a) > 2 to 5 days Evidence for long-range environmental transport	Technical Criteria Half-life (ss) > 16 to 60 days Half-life (w) > 16 to 40 days Suggestive evidence for long-range environmental transport	Technical Criteria Half-life (ss) < 16 days Half-life (w) < 16 days Half-life (a) < 2 days	
	EU RA, IUCLID Datasheet or UNEP SIDS Strong evidence of persistence	EU RA, IUCLID Datasheet or UNEP SIDS Indication of persistence	EU RA, IUCLID Datasheet or UNEP SIDS Indication of NO persistence	

[12] ss = soil or sediment
[13] w = water
[14] a = air

Environmental Fate: Bioaccumulation

Very High (v)	High (H)	Moderate (M)	Low (L)	Very Low (vL)
Stockholm POPs Presence on list EPA TRI PBT List Presence on list EPA PBT List Presence on list EU PBT List Presence on list WA State PBT List Presence on list EU vPvB List Presence on list ECHA Listing SVHC- vPvB or PBT	Canadian DSL PB_iT List Presence on list Canadian DSL B_iT List Presence on list OSPAR Chemicals of Possible Concern PBT List Presence on list OSPAR Chemicals for Priority Action List Presence on list			
Technical Criteria BCF/BAF ≥ 5,000 Log K_{ow}[15] ≥ 5	Technical Criteria BCF/BAF ≥ 1,000 but < 5,000 Log K_{ow} ≥ 4.5 but < 5 Weight of evidence for presence in humans and wildlife	Technical Criteria BCF/BAF ≥ 500 but < 1,000 Log K_{ow} ≥ 4 but < 4.5 Suggestive evidence of presence in humans and wildlife	Technical Criteria BCF/BAF ≥ 100 but < 500	Technical Criteria: BCF/BAF < 100 Log K_{ow} < 4
	EU RA, IUCLID Datasheet or UNEP SIDS Strong evidence of bioaccumulation	EU RA, IUCLID Datasheet or UNEP SIDS Indication of bioaccumulation	EU RA, IUCLID Datasheet or UNEP SIDS Indication of NO bioaccumulation	

[15] Log K_{ow} = logarithm of the octanol/water partition coefficient