

US EPA ARCHIVE DOCUMENT

Indicators and Implicit Weighting Scheme of the Hazard Ranking System (HRS)

Demonstration of MIRA flexible
hierarchy construction and weighting
scheme using HRS variables

What is the HRS?

- Hazard Ranking System established 12/14/90 in the Federal Register (55FR51532), effective March 14, 1991.
- Under Section 105(8)(A) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly called Superfund.
- HRS is a formula used to calculate an environmental score for a contaminated site that considers 4 major pathways: groundwater (S_{GW}), surface water (S_{SW}), soil (S_S), and air (S_A).

HRS Formula

$$\text{HRS} = \sqrt{\frac{S_{GW}^2 + S_{SW}^2 + S_S^2 + S_A^2}{4}}$$

Max pathway value (S) = 100; Max HRS score = 100.

Current Use of HRS

- Based on Federal Register, users evaluate a site by calculating a HRS score to determine priorities among releases or threatened releases of hazardous substances for the purpose of taking remedial action and to determine the urgency of such action.
- BUT HRS could be used in other ways and the same components could be considered more flexibly depending on availability of data, stakeholders, and specific application...

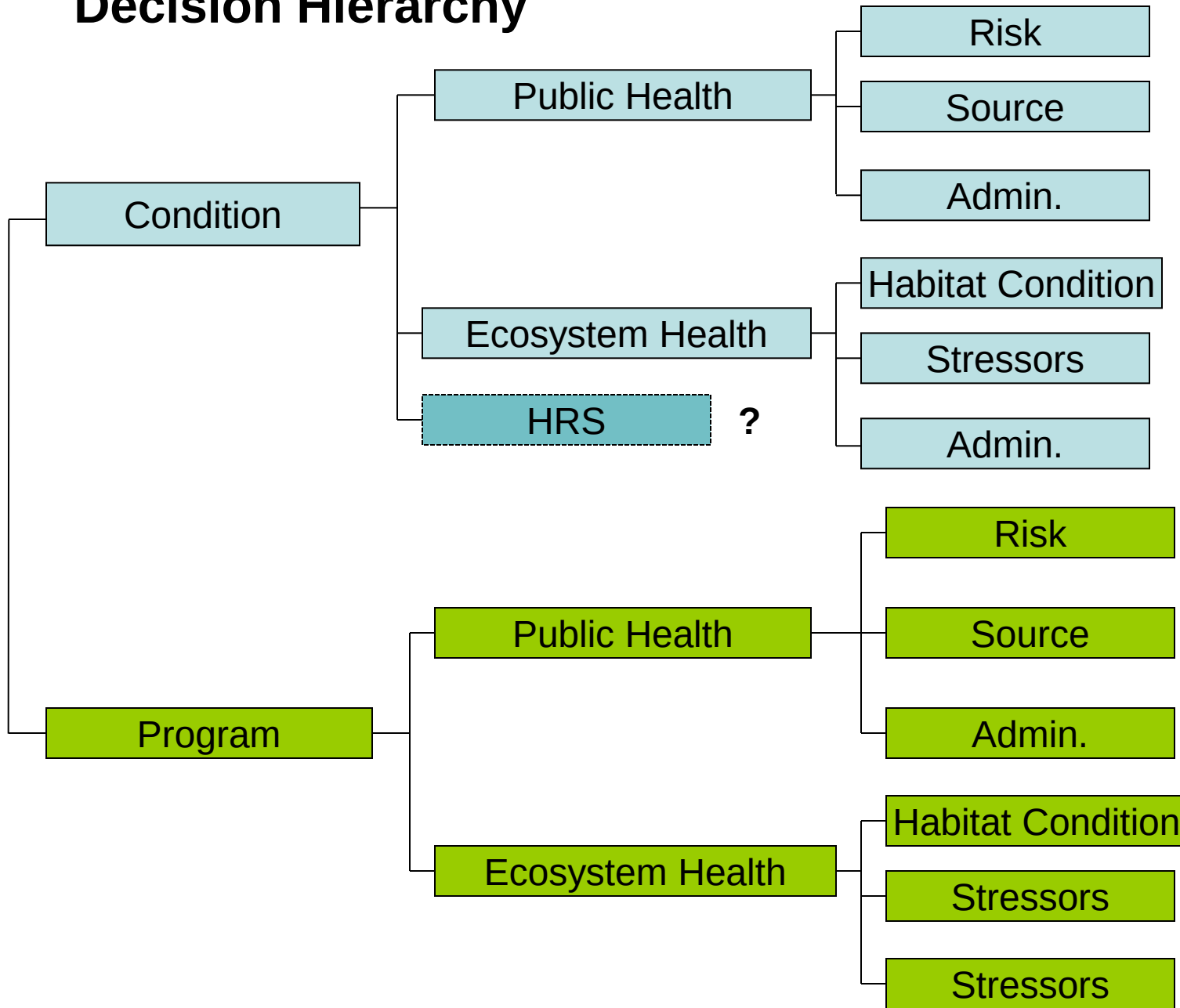
Hazard Ranking System (HRS) Example

- Possible to use HRS score in different ways with MIRA:
 - Option 1: Use HRS as a decision criterion.
 - Option 2: Use HRS criteria and allow for flexibility for expert input and decision maker judgment.
 - Appropriate when you don't have or can't get type of data required by HRS; i.e., need to use surrogate indicators.

Option 1: HRS as Criterion

- Suppose you want to evaluate both the **condition** of the region and **program** effectiveness within the region to include:
 - Public health impacts
 - Ecological impacts
 - Balance condition with program (in)effectiveness.
- Possible to set up a decision hierarchy something like this...

Option 1: Sample MIRA Decision Hierarchy



Option 1: Indicator Examples

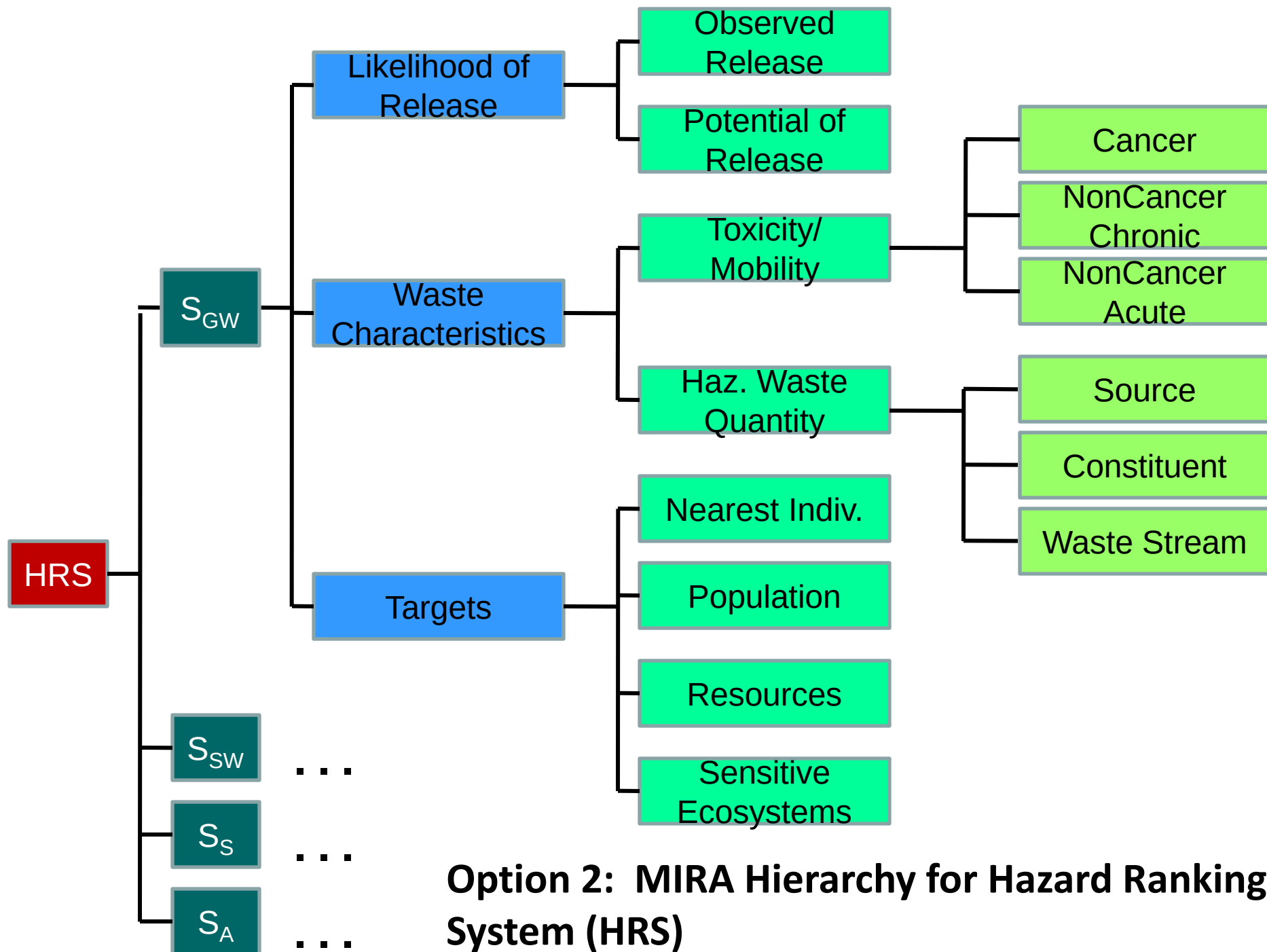
- Condition
 - **HRS score**
 - Economic/social costs
 - Ozone concentration, Nutrient load
 - Cancer risk, Exposure
- Program
 - # permits/regulations approved; % impaired streams
 - % regulations that include evaluation of alternative control technologies.
 - Amount of time between submittal and approval of...regulation/permit/plan.
 - **“x” type of Hazardous Waste implementation plan producing change/improvement in “y” type of risk parameter by “z” amount.**

Option 1: How to use HRS with other criteria

- Need to consider the **relative** environmental significance of HRS with other criteria.
 - Expert discussion
 - What does HRS indicate? Is it a more decision significant indicator than economic cost (for example)?
 - If you believe no other criterion than HRS needs to be considered, you don't need MIRA.

Option 2: Using HRS criteria as the analysis

- Suppose you only want to consider hazardous waste criteria as currently used in calculating HRS...
- OR: You are unable to get data required/expected by HRS and must use surrogate indicators...
- Possible to set up decision hierarchy as follows...



HRS Calculation Example 1

- HRS: **Likelihood of Release (LR)** = greater of observed release or potential to release
 - To replicate in MIRA: one of these criterion will have a weight of zero in the calculation (Other = 1.0).
 - MIRA alternative (if not regulatory): weight these criteria in any way that adds up to 1.0 (or 100%).

HRS Calculation Example 2

- HRS Calculation Methodology
- Pathway Score, $S = (\text{Likelihood of Release} \times \text{Waste Characteristics} \times \text{Targets}) / 82,500$
 - Max values for LR = 550, Waste = 100, Targets = 150.

Cont'd Example 2

- To replicate in MIRA:
 - Calculate relative weights for each of 3 factors.
 - E.g. LR weight = $(550/82,500)/(550/82,500 + 100/82,500 + 150/82,500) = 0.691$
 - (LR) x 0.691 x (waste) x 0.124 x (targets) x 0.185
(Fixed weights via HRS method)
 - Likelihood of Release is designed to be the most important criterion in the HRS calculation method (69% vs. 12% vs. 18%).
- With MIRA, you can change weights if desired (and allowed by law).

HRS Calculation Example 3

- $$\text{HRS} = \sqrt{\frac{S_{\text{GW}}^2 + S_{\text{SW}}^2 + S_{\text{S}}^2 + S_{\text{A}}^2}{4}}$$
- Max pathway score (S) = 100.
- HRS equation appears to weight all pathways equally BUT actually weights the pathway score that is highest most heavily (due to squaring).
- In MIRA: possible to replicate weights via above equation or use other weights.

Option 2: HRS Component analysis with MIRA

- What's different about using HRS criteria in MIRA vs. just calculating HRS?
 - Allows for **transparency** in seeing relative importance (weights) of all the criteria composing the HRS.
 - Possible to use **additional criteria** (economic/ social) if desired.
 - Possible to use **surrogate criteria** if data required by HRS is not available.
- If law requires HRS method, using MIRA is not an option.
 - BUT could use MIRA to inform other decisions.

Summary: Advantages to using HRS in MIRA under Options 1 or 2

- Option 1: Consider other important criteria (i.e. consider hazardous substance pathways and other criteria)
- Option 2: Even when limiting analysis to hazardous substances, allow for different stakeholder perspectives of relative pathway importance.