European Commission

eftec

STRATUS CONSULTING

ENVIRONMENTAL LIABILITY DIRECTIVE - OVERVIEW

2 Days Training Session

Outline

- What is ELD and who does it concern?
- The ELD simplified: An Illustration
- Overview of the ELD
  - How to decide if ELD applies to an activity?
  - How to decide if ELD applies to an incident?
  - Costs and financing
- Future of the ELD
- Overview of the implementation process: planning remediation

The Purpose of the ELD

- To **prevent** (art. 5 and 8) and **remedy** (art. 6, 7, 8 and Annex II) environmental damage by establishing a framework on environmental liability based on the polluter pays principle

- Damaged resources and services must be returned to baseline conditions.

Polluter pays-principle

- Operators causing the damage or imminent threat of damage have to prevent and remedy the damage and to bear the necessary costs

- Polluter must undertake or pay for ‘compensation in kind’. Monetary compensation is not permitted.

Enabled Persons

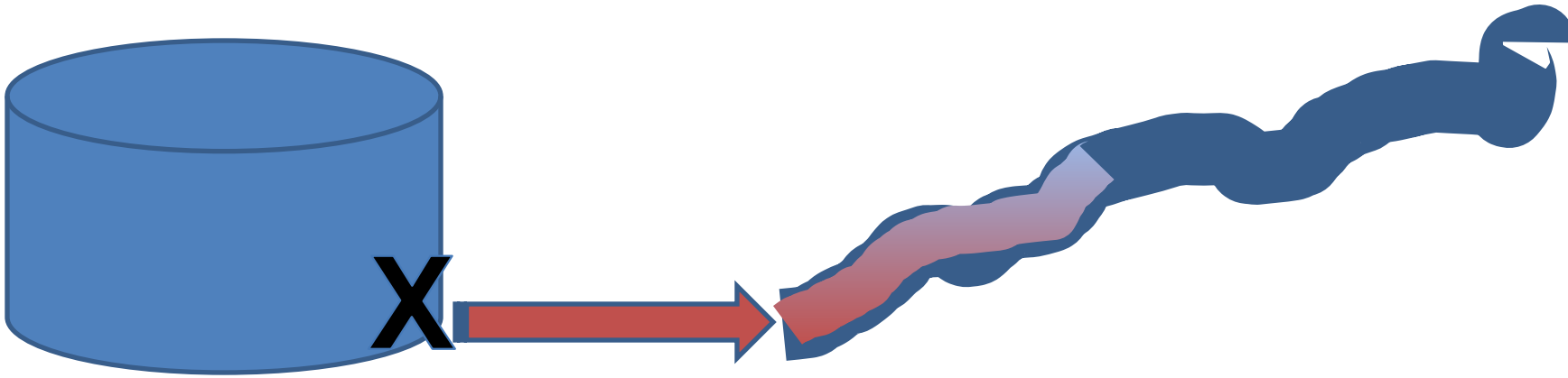
- Anyone…
  - *Who is affected or likely to be affected by damage (e.g. residents, birdwatchers, ramblers, recreational fishermen, those whose health may be at risk from contaminants, those responsible for children or elderly persons whose health may be at risk)*
  - *Who otherwise has a sufficient interest or alleges the impairment of a right (including but not limited to NGOs)*
- …is an "Enabled Person" and may notify the Competent Authority of damage or imminent threats of damage

Key Stakeholders in the Process

- Competent Authorities
- Operators
- Financial service providers and others
- Enabled Persons
- *Other participants (non-Stakeholder) in the process can include experts (science, economics, law) and the public*

The ELD Simplified

- An incident occurs that adversely affects the environment
  - For example, a tank containing hazardous chemicals ruptures and contaminants flow into a nearby river.



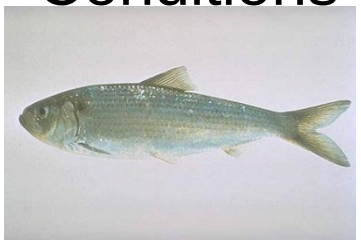
Before the ELD case…

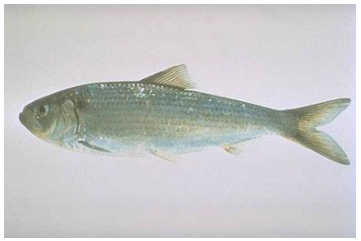
- The Operator takes steps to stop the pollution
  - Fix the broken tank
- The Operator may take steps to do some clean-up of contaminated soils or sediments
  - Add neutralizing agent
  - Excavate soil or sediment

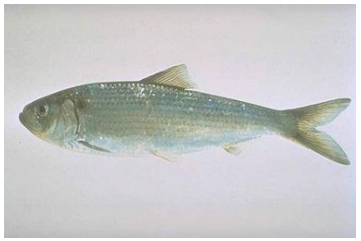
Effects of the Spill on the Environment

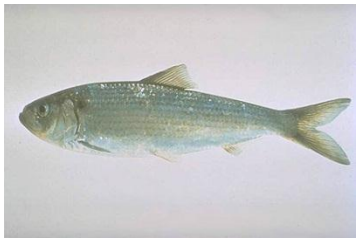
Pre-Spill

Conditions



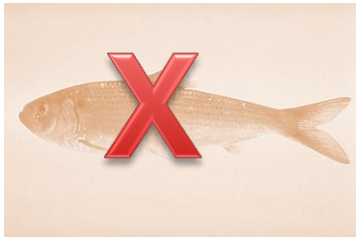


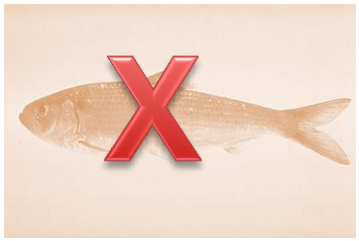


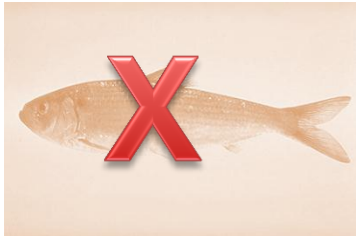


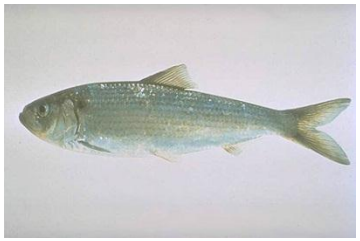
Post-Spill

Conditions

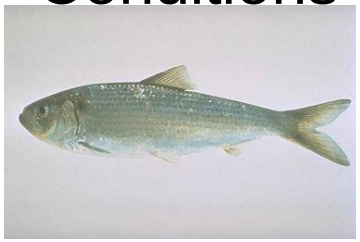
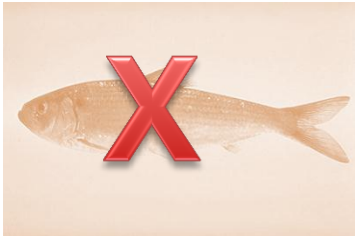
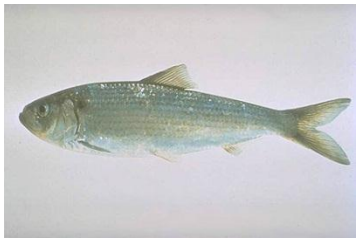
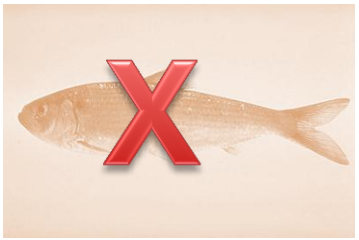
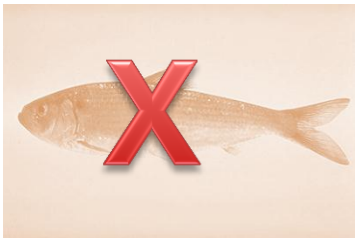
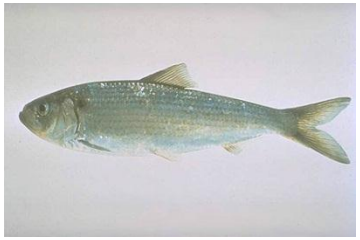
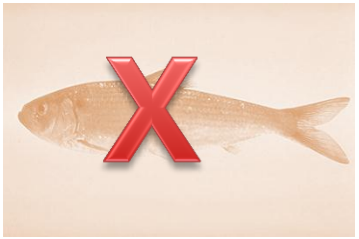
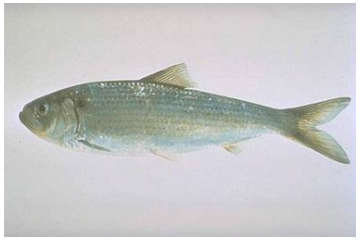
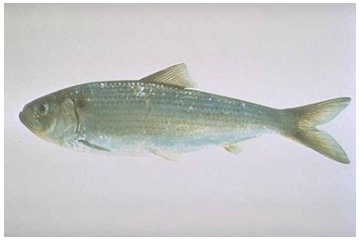
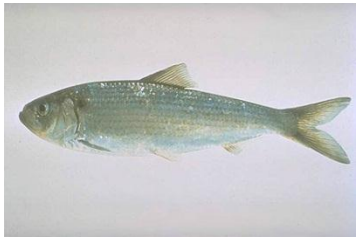
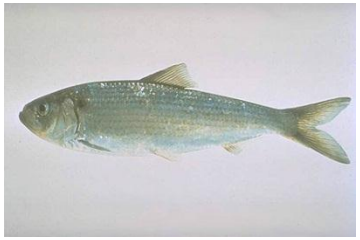








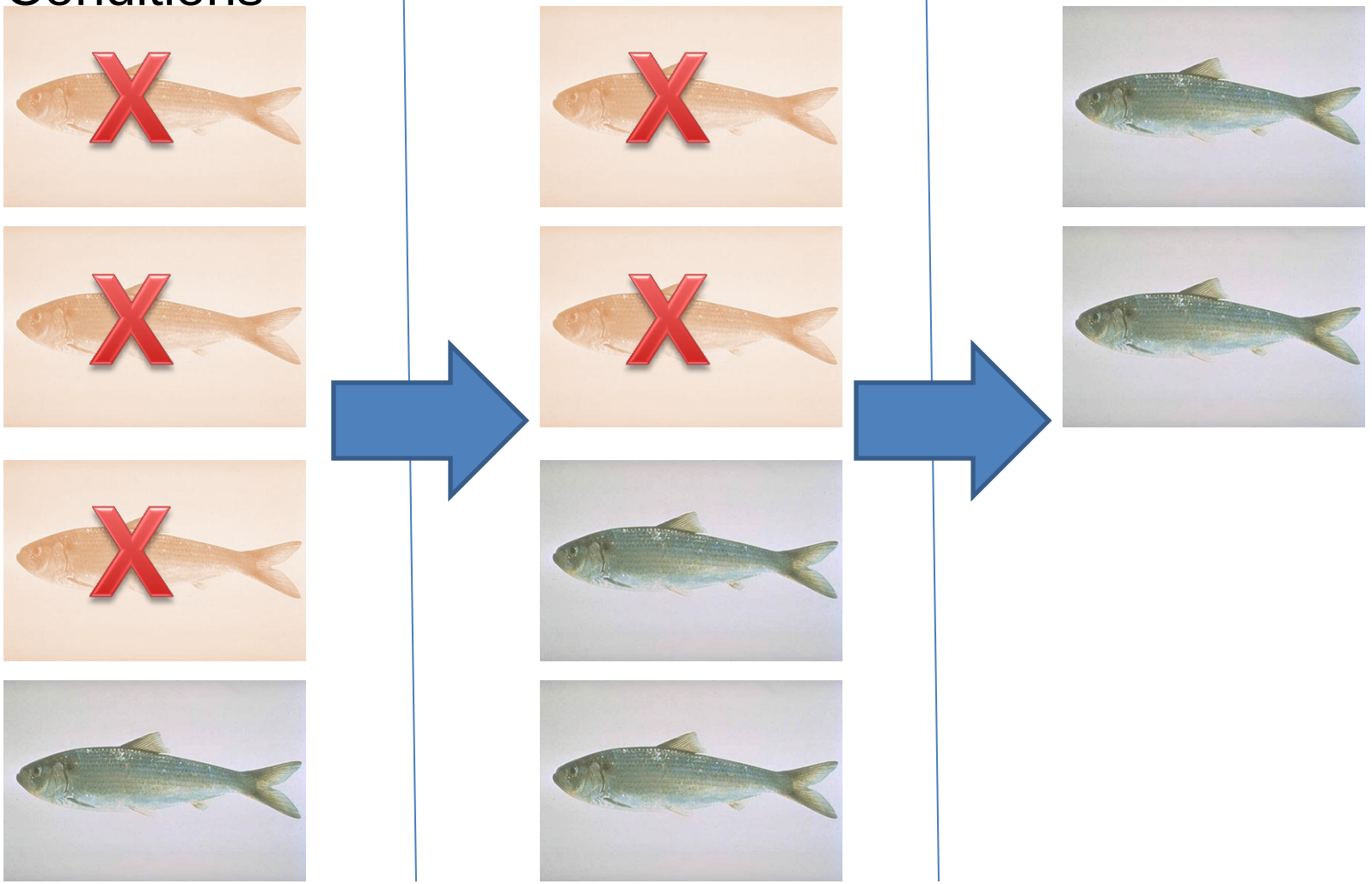
Benefits of Cleanup Actions

Pre-Spill Conditions	Post-Spill Conditions	Post-Cleanup
		
		
		
		

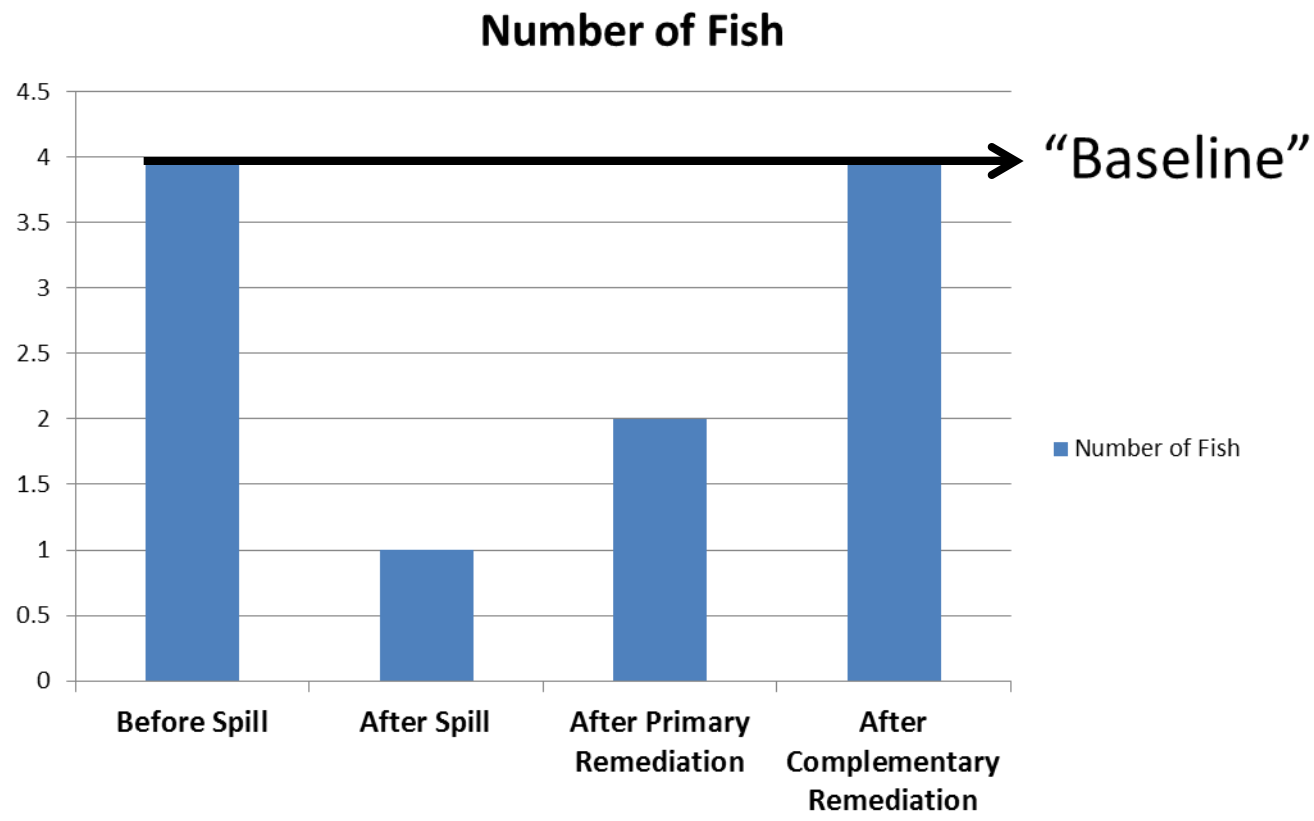
Cleanup Actions Don't Fully Restore the Fishery

Additional Remediation is Needed

Post-Spill Conditions	Post-Cleanup	Full Remediation



“Remediation” according to the ELD



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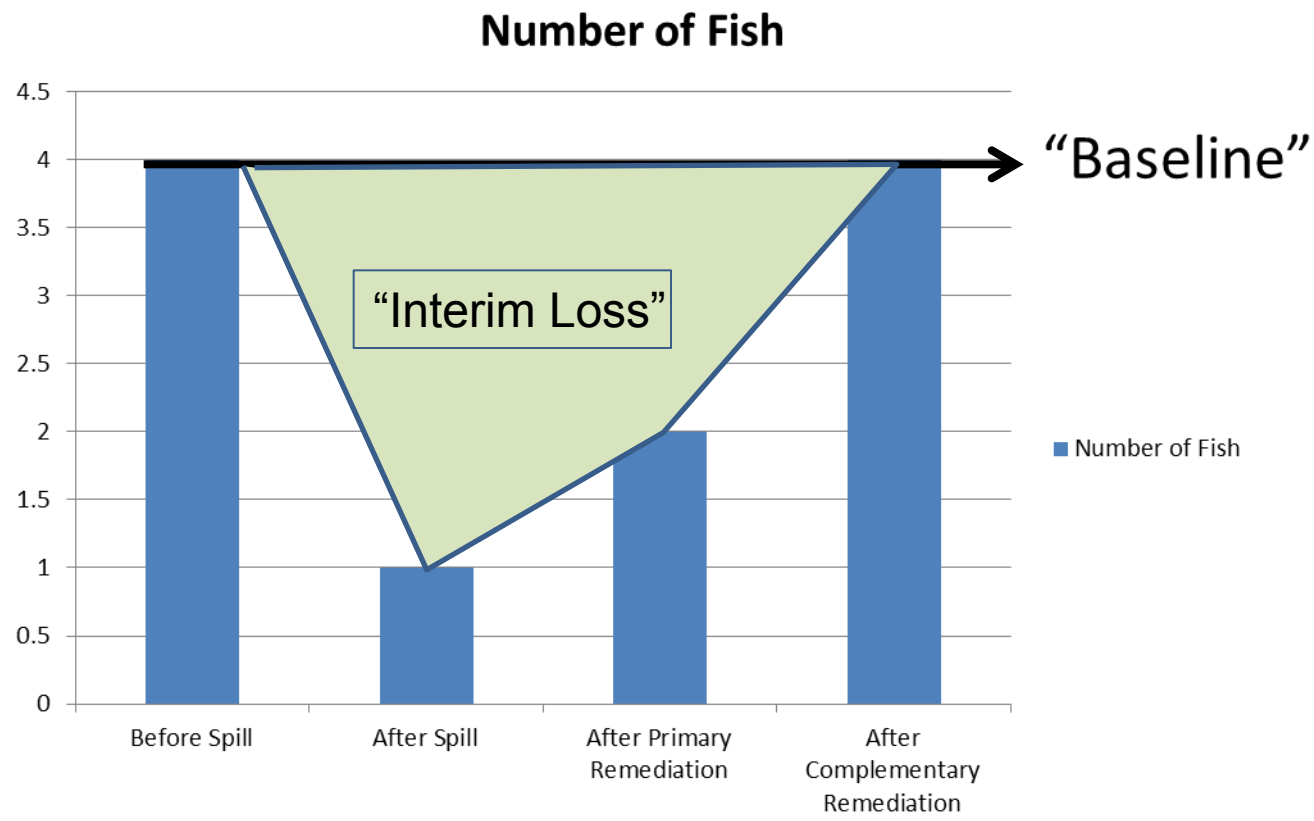

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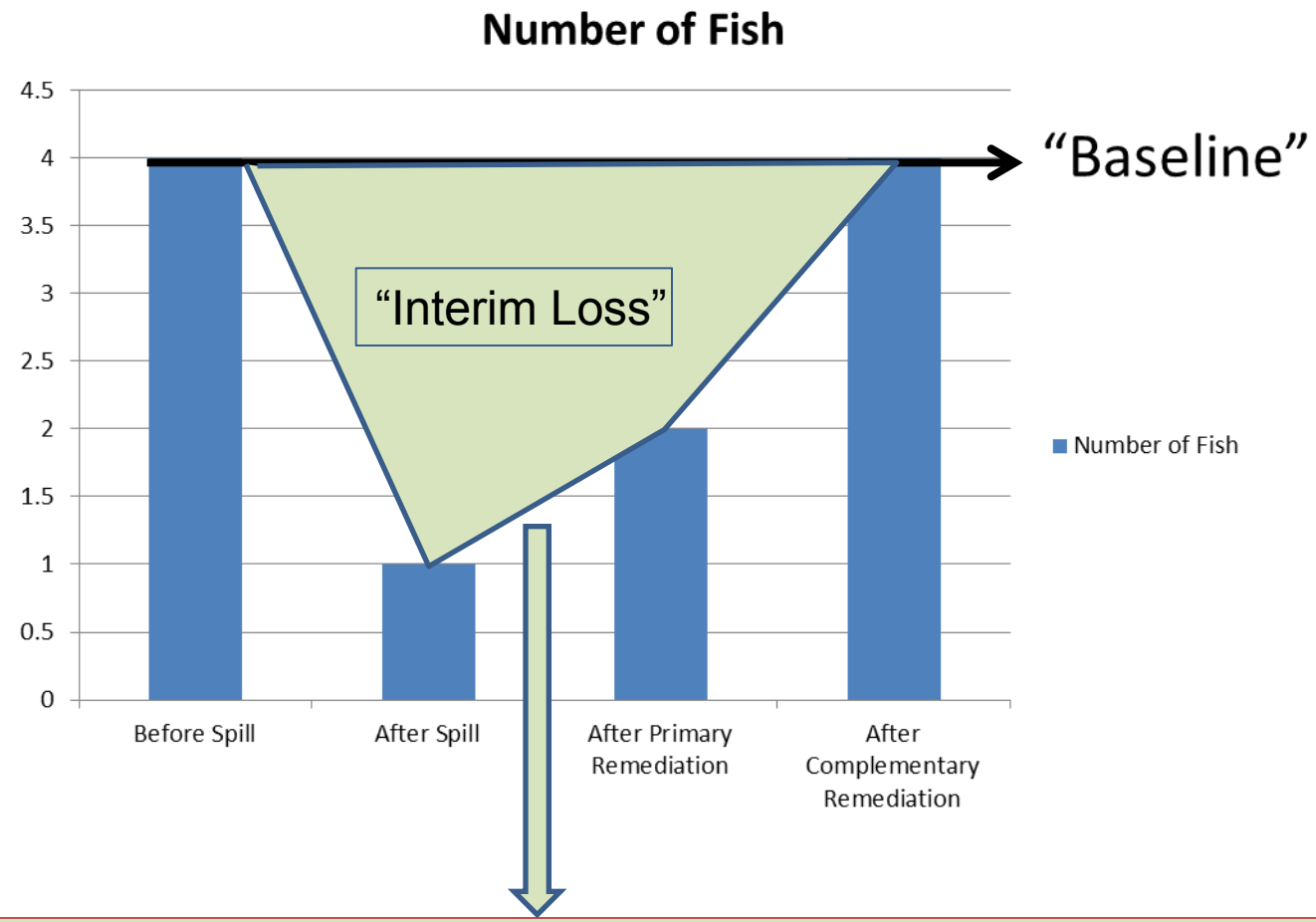
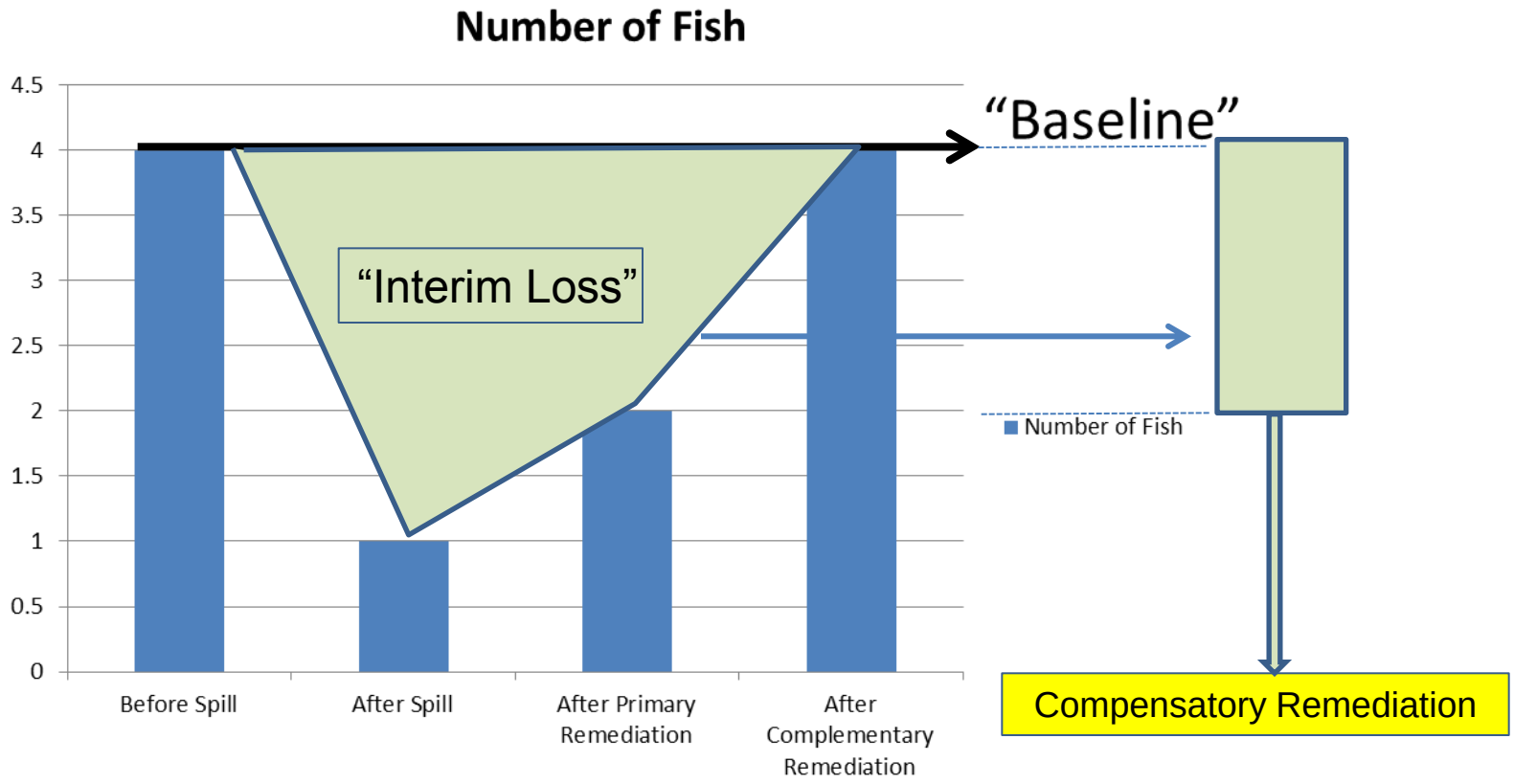


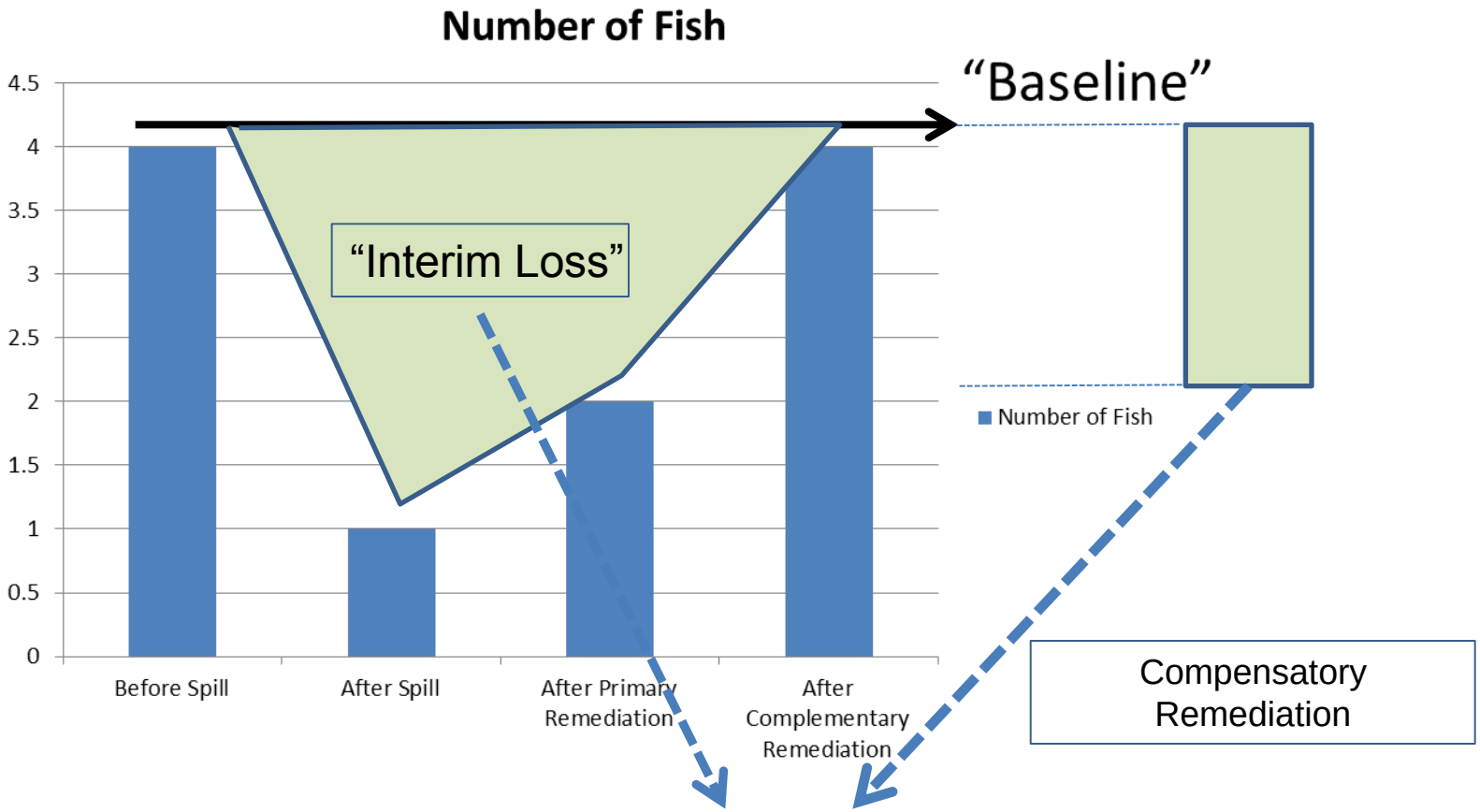
As the reduction from baseline increases, Interim Loss increases.
As the time to return to baseline increases, Interim Loss increases.

“Remediation” according to the ELD



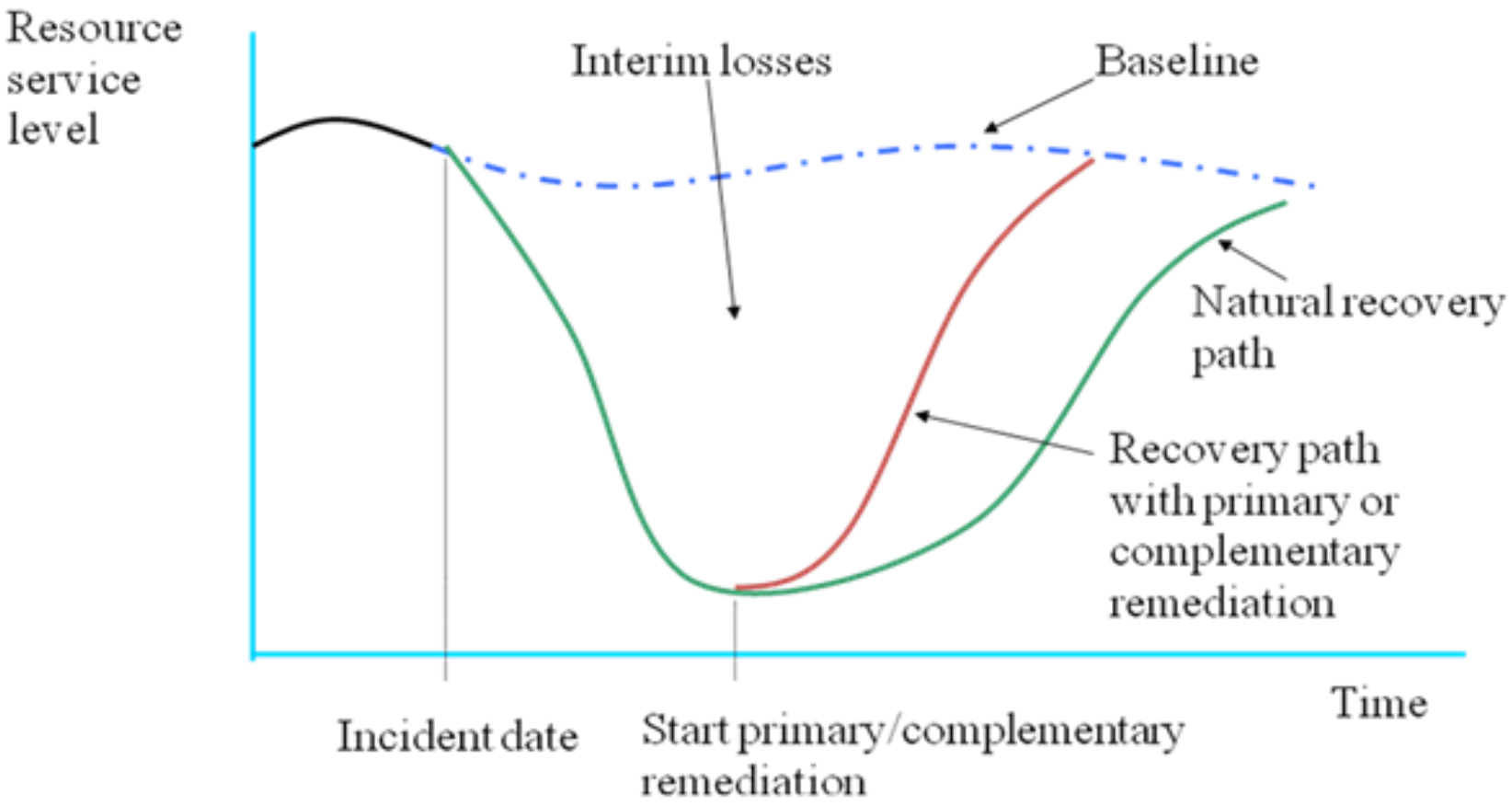
Compensatory Remediation is the remediation required to compensate for the interim loss not accounted for through primary or complementary remediation.

“Remediation”: in the Language of the ELD



“Resource Equivalency Method”:
Calculating or “Scaling” Compensatory Remediation to Offset Interim Loss

Anatomy of damage



How to judge if ELD applies to an ‘activity’?

What are ELD Resources?

- Protected habitats and species
- Water
- Land

Damage to protected habitats and species

- Only covered if damage has “significant adverse effects on reaching or maintaining the favourable conservation status” of the habitats and species concerned (**Habitats and Birds Directives**)
  - Interpretation of significance
    - Measurable
    - Annex I

Damage to water

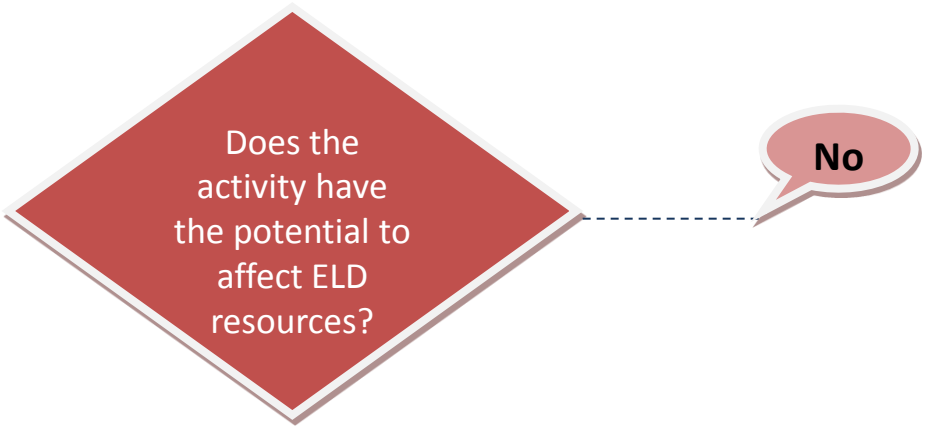
- Any damage that significantly adversely affects the ecological, chemical and/or quantitative status and/or ecological potential, as defined in the **Water Framework Directive** (2000/60/EC), of the waters concerned, with the exception of adverse effects where Article 4(7) of that Directive applies

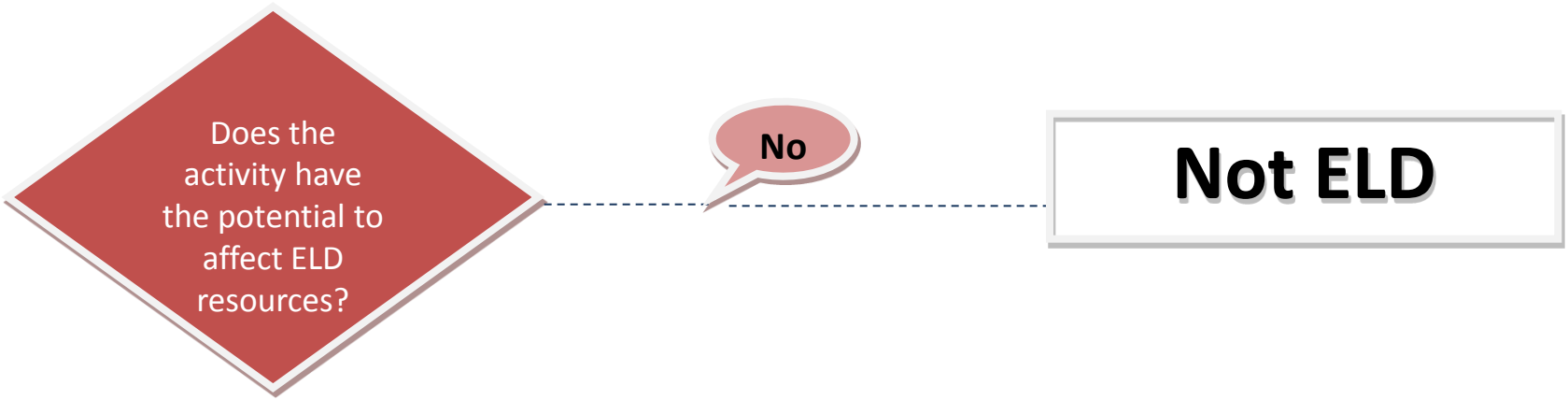
ELD and Water Framework Directive

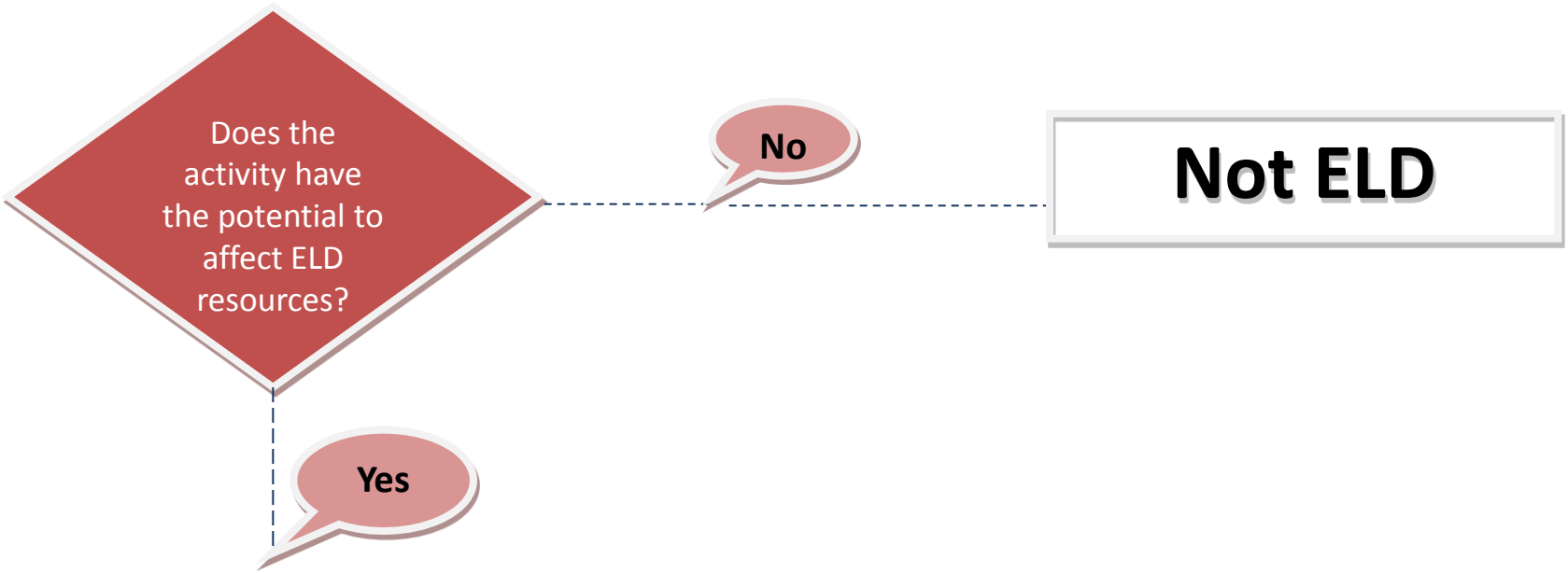
- Definition of waters in ELD is based on WFD
- Good ecological status and other work under WFD (Annex V) will help determine the baselines that can also be used for ELD

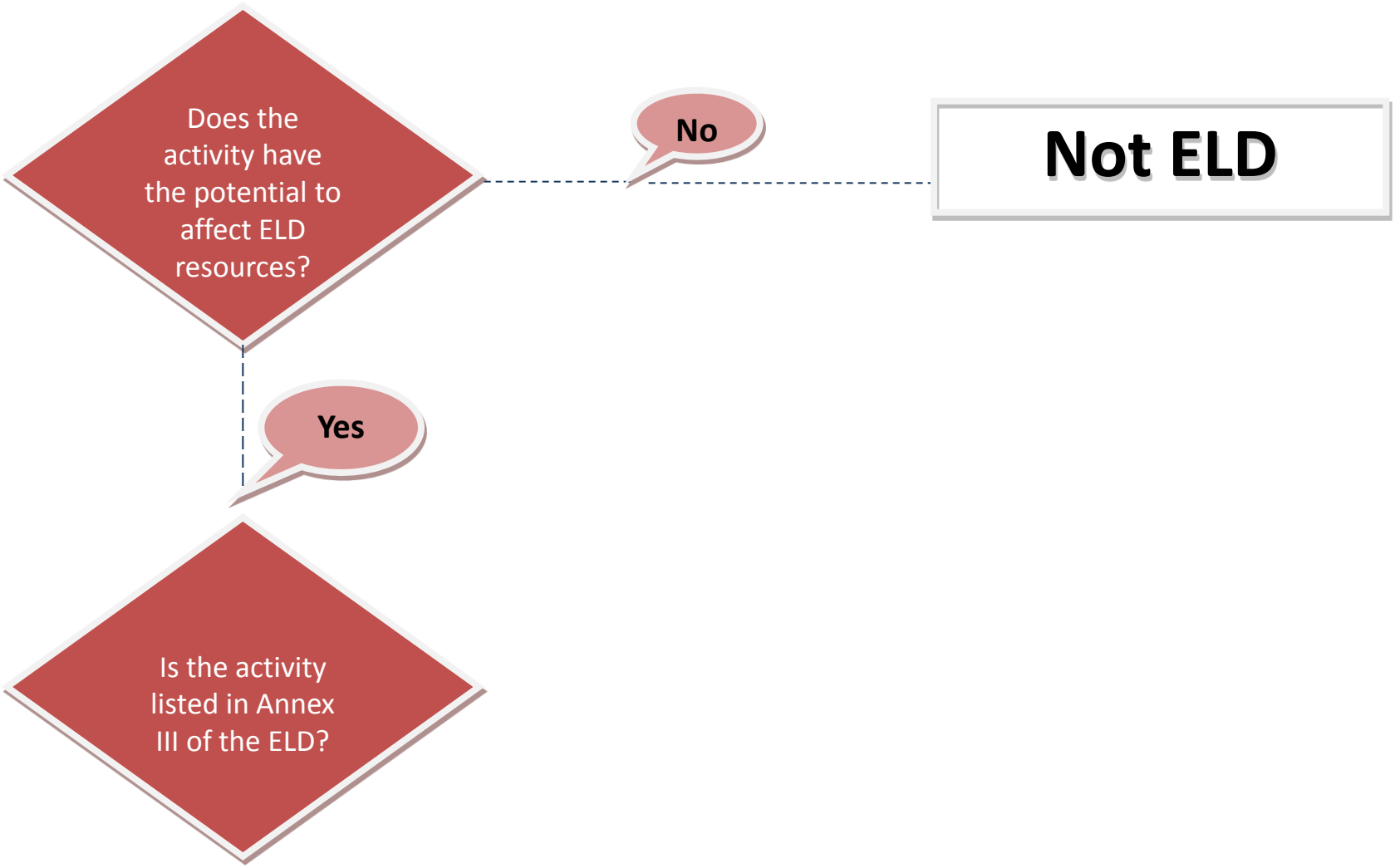
Damage to land

- If the land contamination creates a “significant risk to human health being adversely affected” – no reference to natural resources



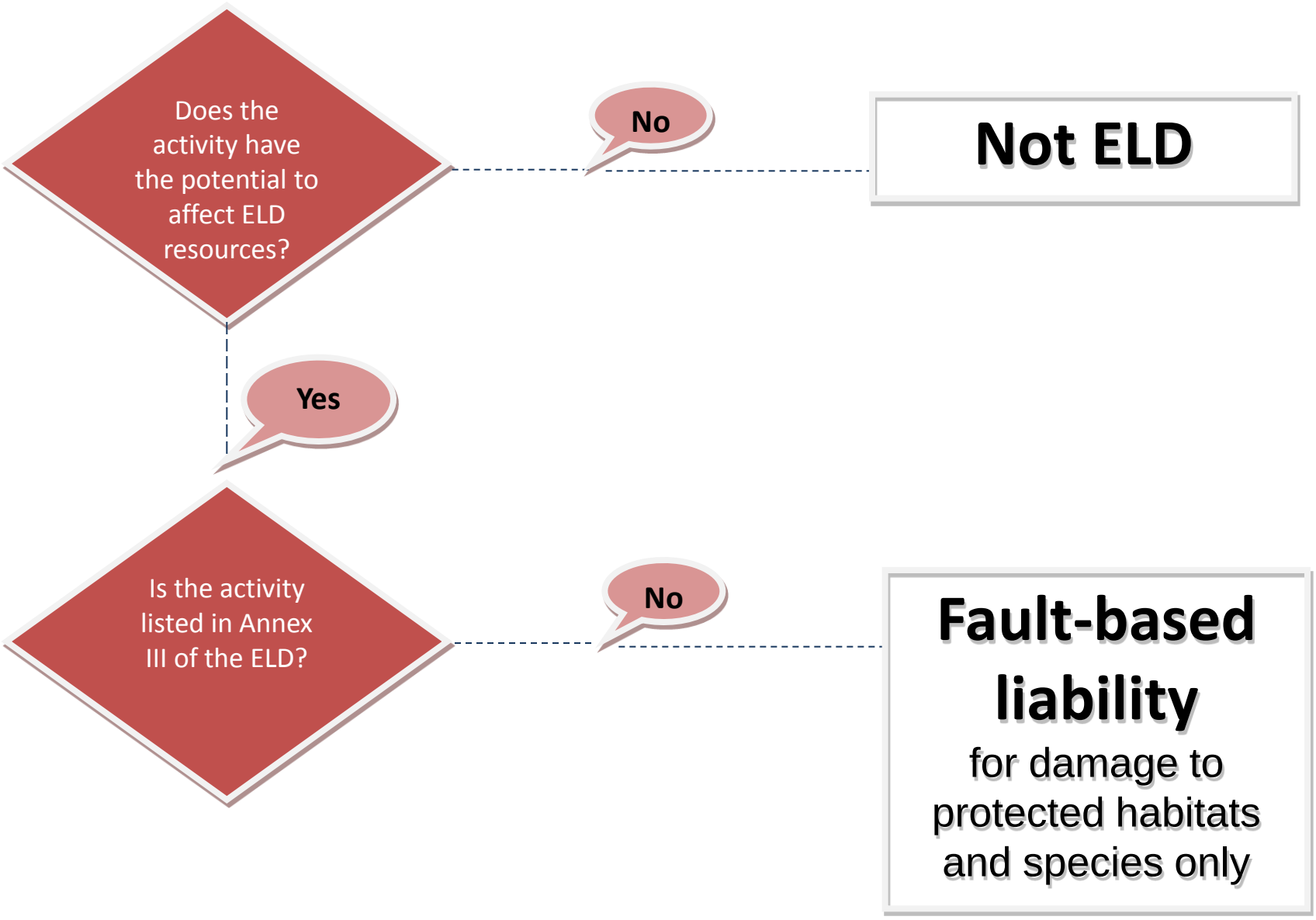


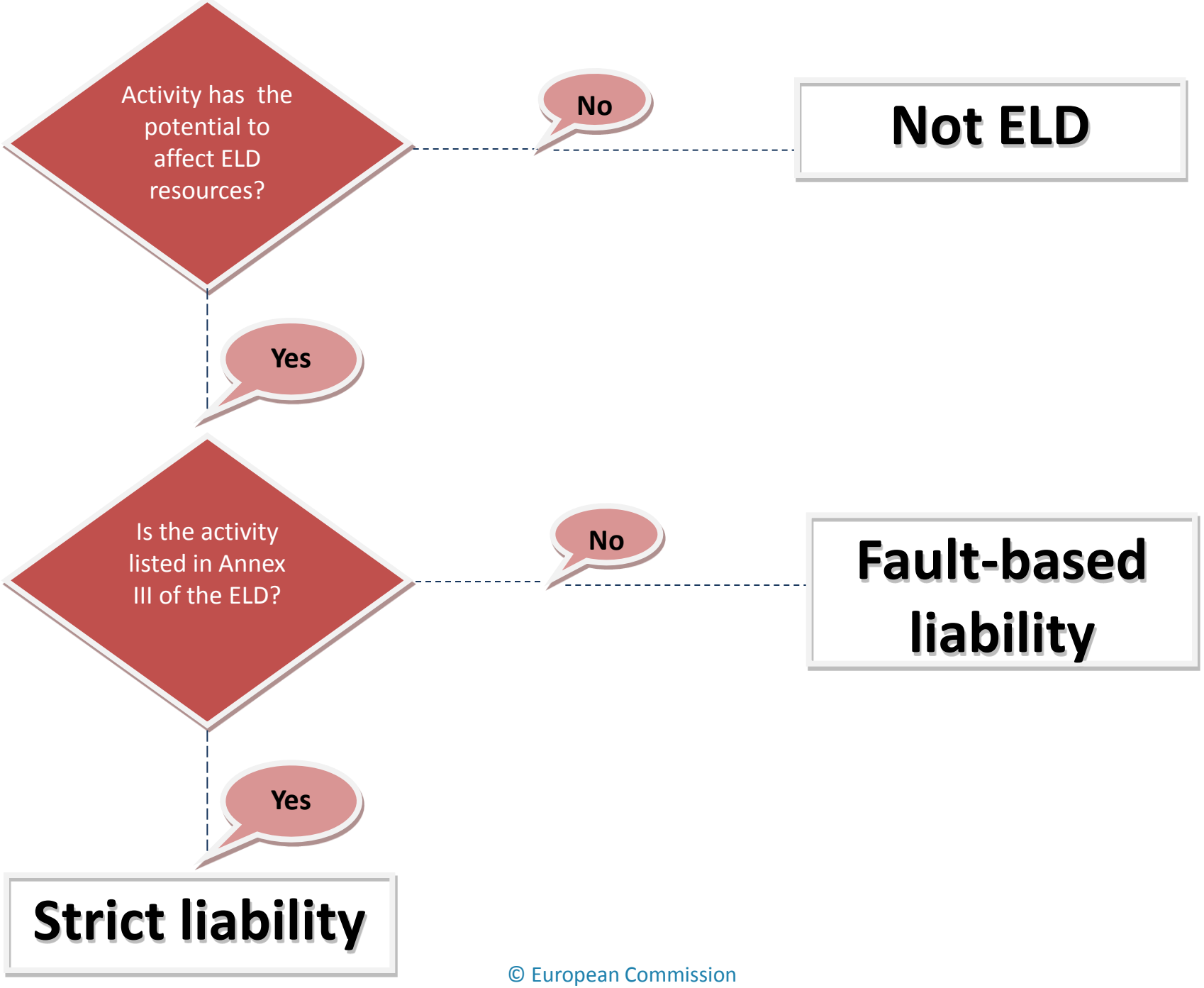




Annex III activities

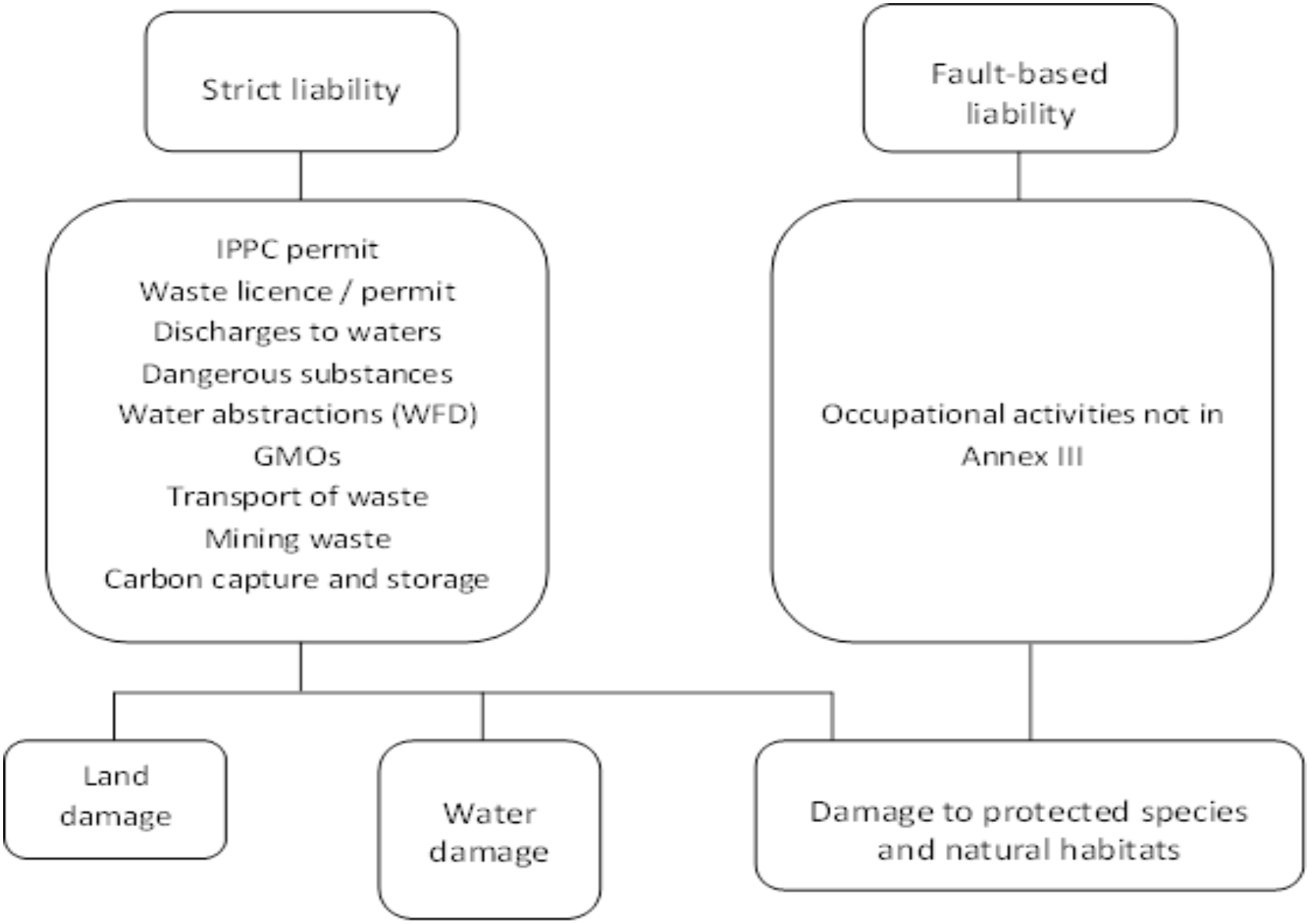
- IPPC permit
- Waste licence / permit
- Discharges to waters
- Dangerous substances
- Water abstractions (WFD)
- GMOs
- Transport of waste
- Mining waste
- Carbon capture and storage

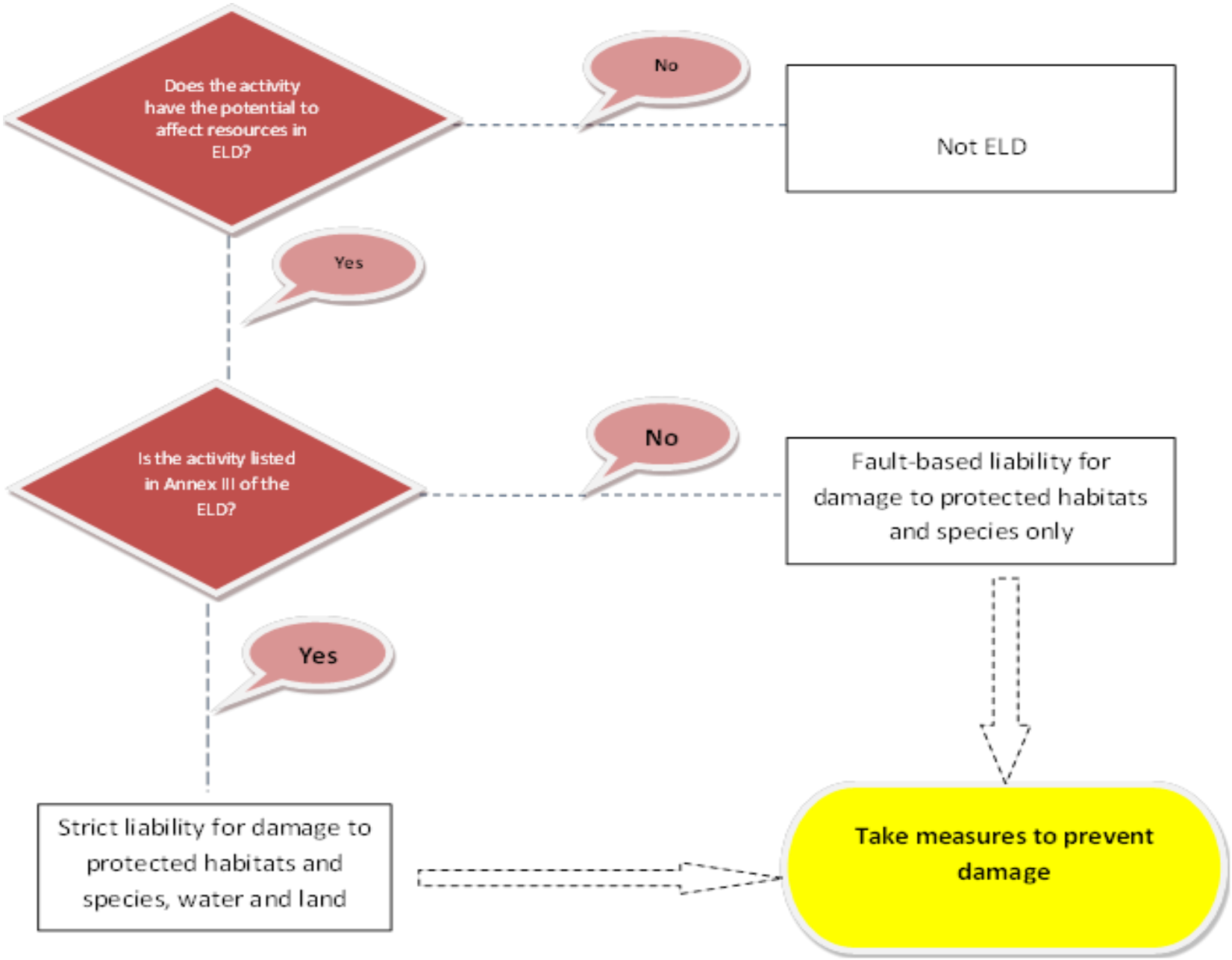




Standards of liability

- Strict liability
  - Considered to be risky activities. Fault need not be established for the operator to be held liable for the type of damages covered by the ELD
  - Annex III of the ELD
- Fault based liability
  - **Only be held liable for damage to protected species and natural habitats** and not for the other types of environmental damage. Fault or negligence needs to be established.
  - All occupational activities not listed in Annex III





Who does What?
Pre-incident

- During normal operation
- Competent Authorities and Operators:
  - not part of the obligatory content of the ELD but advice based on common good practice
- Financial security providers and experts:
  - Not a duty under the ELD but possible role

Who does What?
Pre-incident

Competent Authority
• May encourage the operator or take measures to reduce risk of incident or imminent threat • Shall encourage or require financial security

Who does What?
Pre-incident

Competent Authority

- May encourage the operator or take measures to reduce risk of incident or imminent threat
- Shall encourage or require financial security

Operator

- May choose to implement measures to reduce risk
- May/must arrange for financial security

Who does What?
Pre-incident

Competent Authority
• May encourage the operator or take measures to reduce risk of incident or imminent threat • Shall encourage or require financial security

Operator
• May choose to implement measures to reduce risk • May/must arrange for financial security

Financial Security Providers
- respond to requests for adequate financial security - consider undertaking assessments of potential risks, costs and premiums for adequate financial security

Who does What?
Pre-incident

Competent authority

- May encourage or take preventative measures
- Shall encourage or require financial security

Financial security providers

- respond to requests for adequate financial security
- consider undertaking assessments of potential risks, costs and premiums for adequate financial security

Operator

- May choose to implement measures to reduce risk
- May/must arrange for financial security

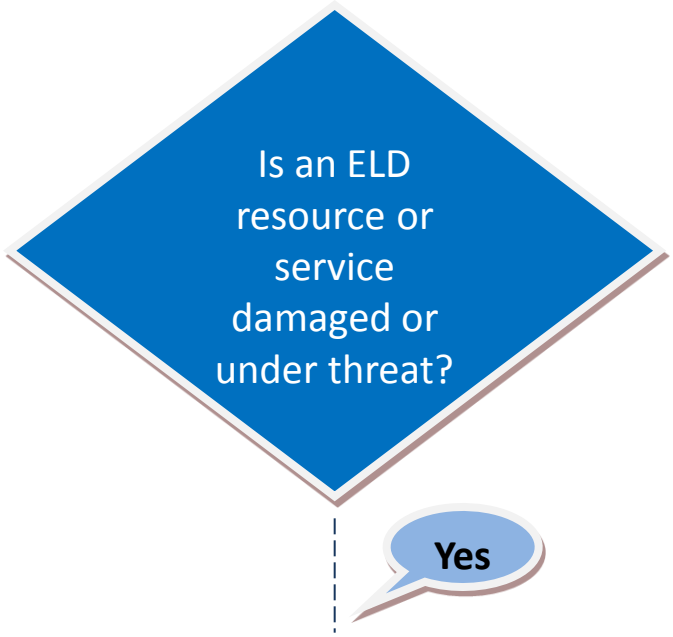
Experts

- technical input to measures to reduce risk of imminent threat and damage

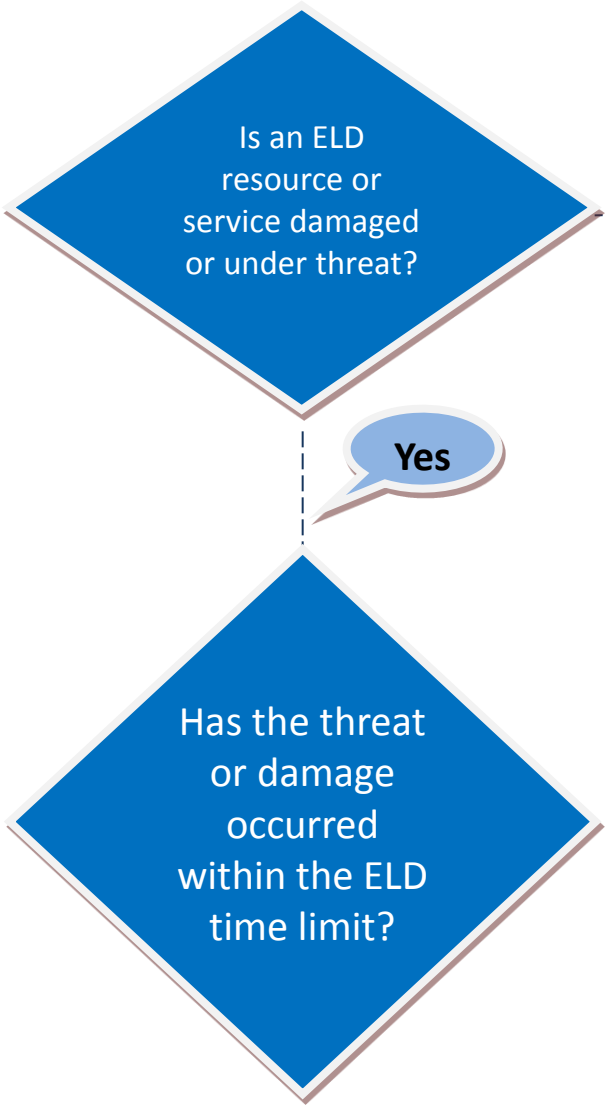
How to judge if ELD applies to a case?

ELD Resources and Services

- Resources:
  - Protected natural habitats and species (Habitats Directive, Birds Directive)
  - Water (Water Framework Directive)
  - Land (health risks only)
- Services provided by these resources



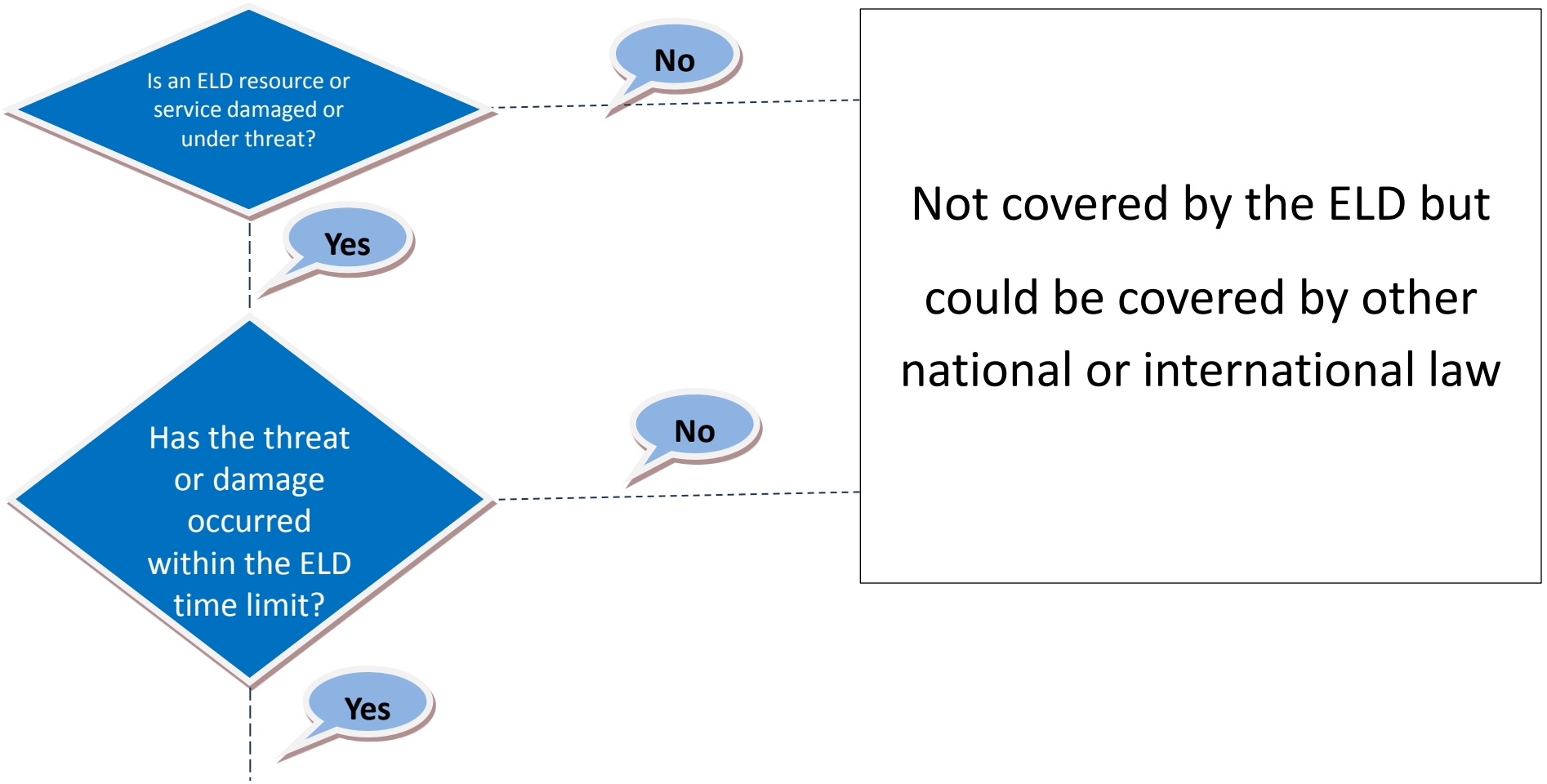
Not covered by the ELD but could be covered by other national or international law

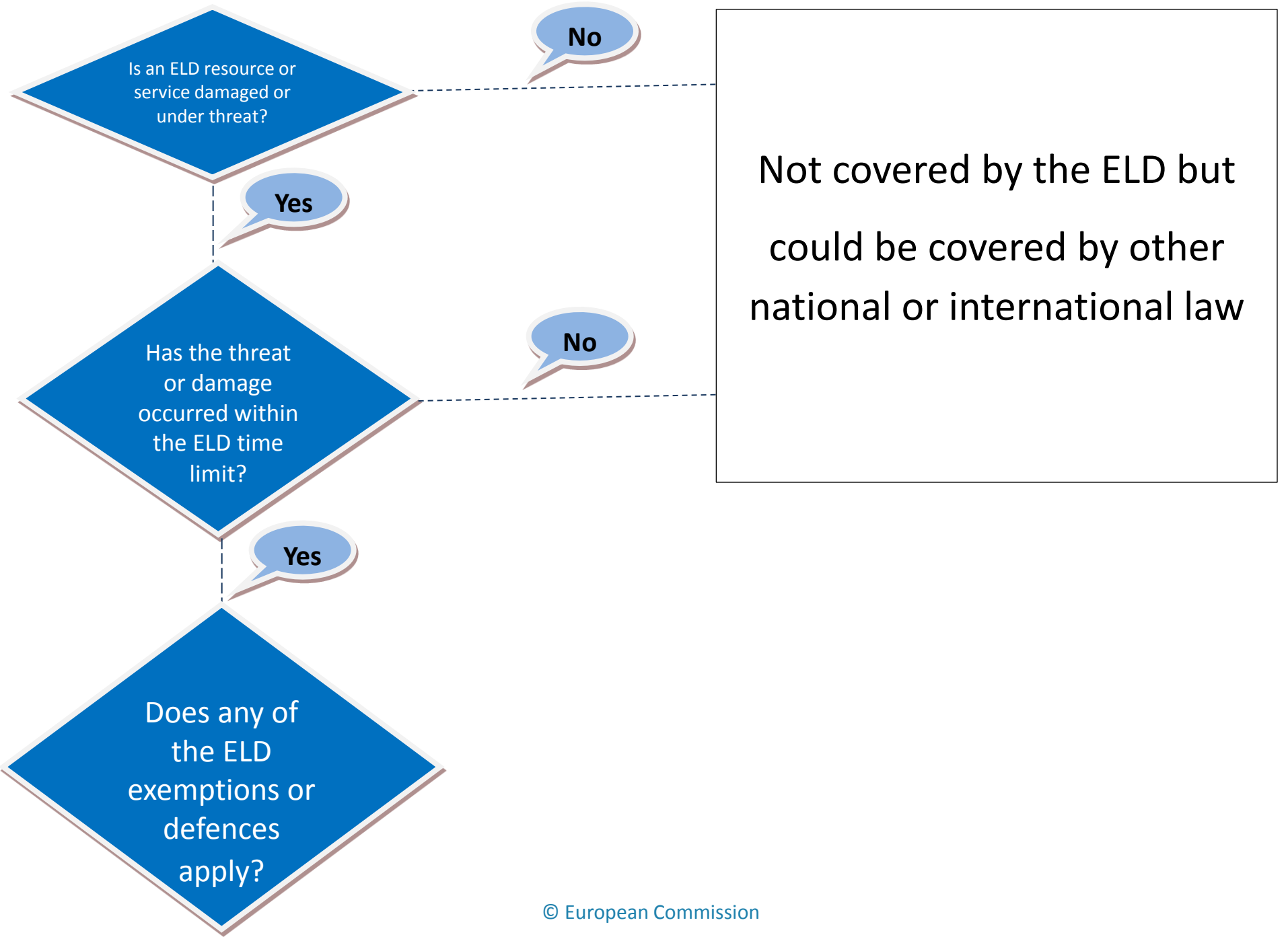


Not covered by the ELD but could be covered by other national or international law

ELD Time Limit

- Before 30 April 2007, if the damage and the underlying causative activity occurred wholly before that date;
- Events or incidents that took place 30 years before the damage having been detected; and
- If more than 5 years have passed since preventive or remedial actions were completed, or the responsible party was identified, whichever is the later





Exemptions

- Coverage by International Conventions, Euratom Treaty
- Act of armed conflict, hostilities, civil war or insurrection
- A natural phenomenon of exceptional, inevitable and irresistible character
- Activities, the main purpose of which is to serve national defence or international security or protection against natural disasters
- Diffuse pollution and causality

Defences

- Third party defence
- Compulsory order defence
- Permit defence
- State of the art defence

Third Party Defence, Compulsory Order Defence

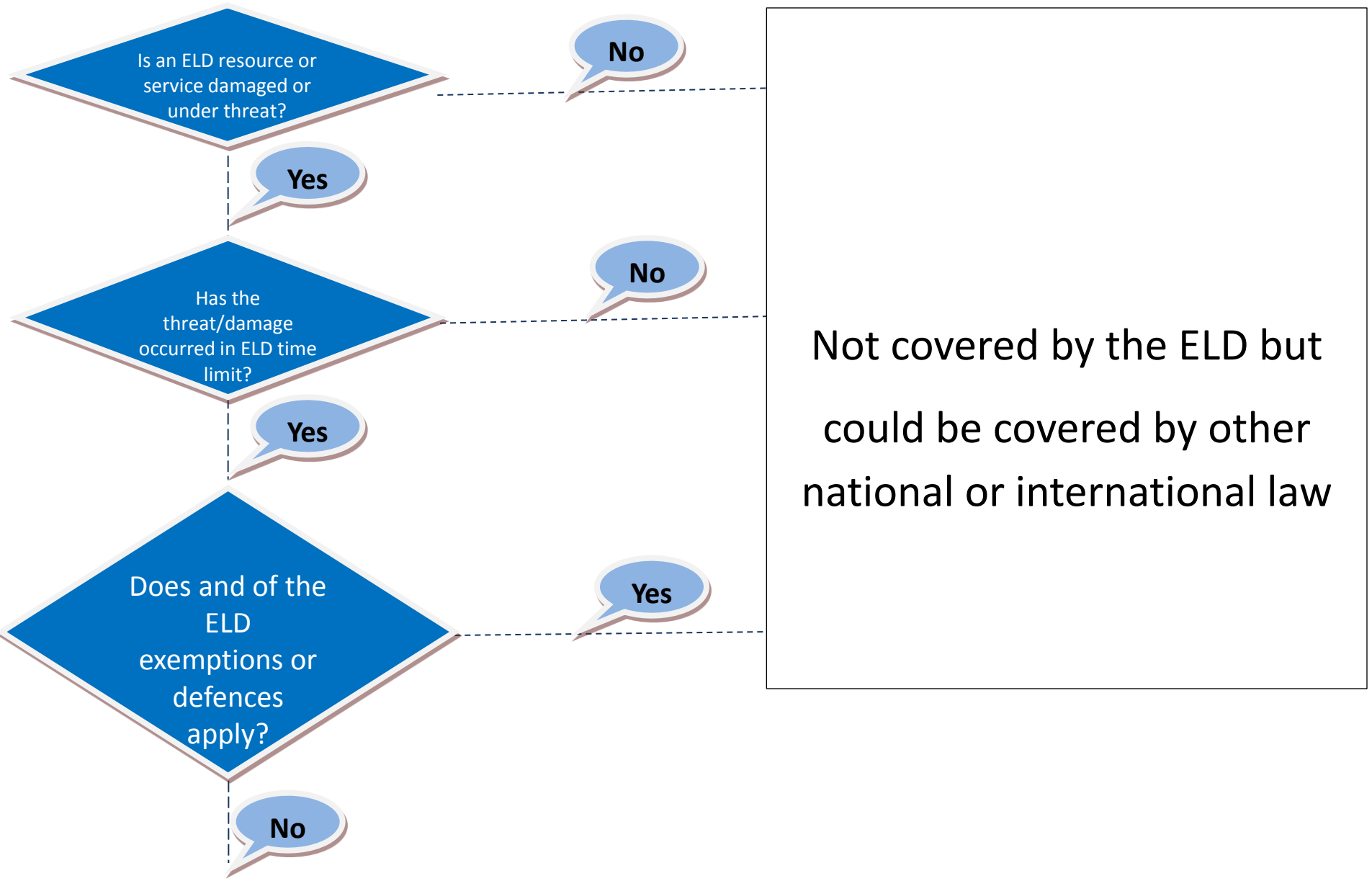
- If the operator proves that
  - the damage was caused by a third party (provided appropriate safety measures were in place), or
  - If the damage resulted from compliance with an order or instruction from a public authority, unless that order was in response to an emission or incident caused by the operator's own activities

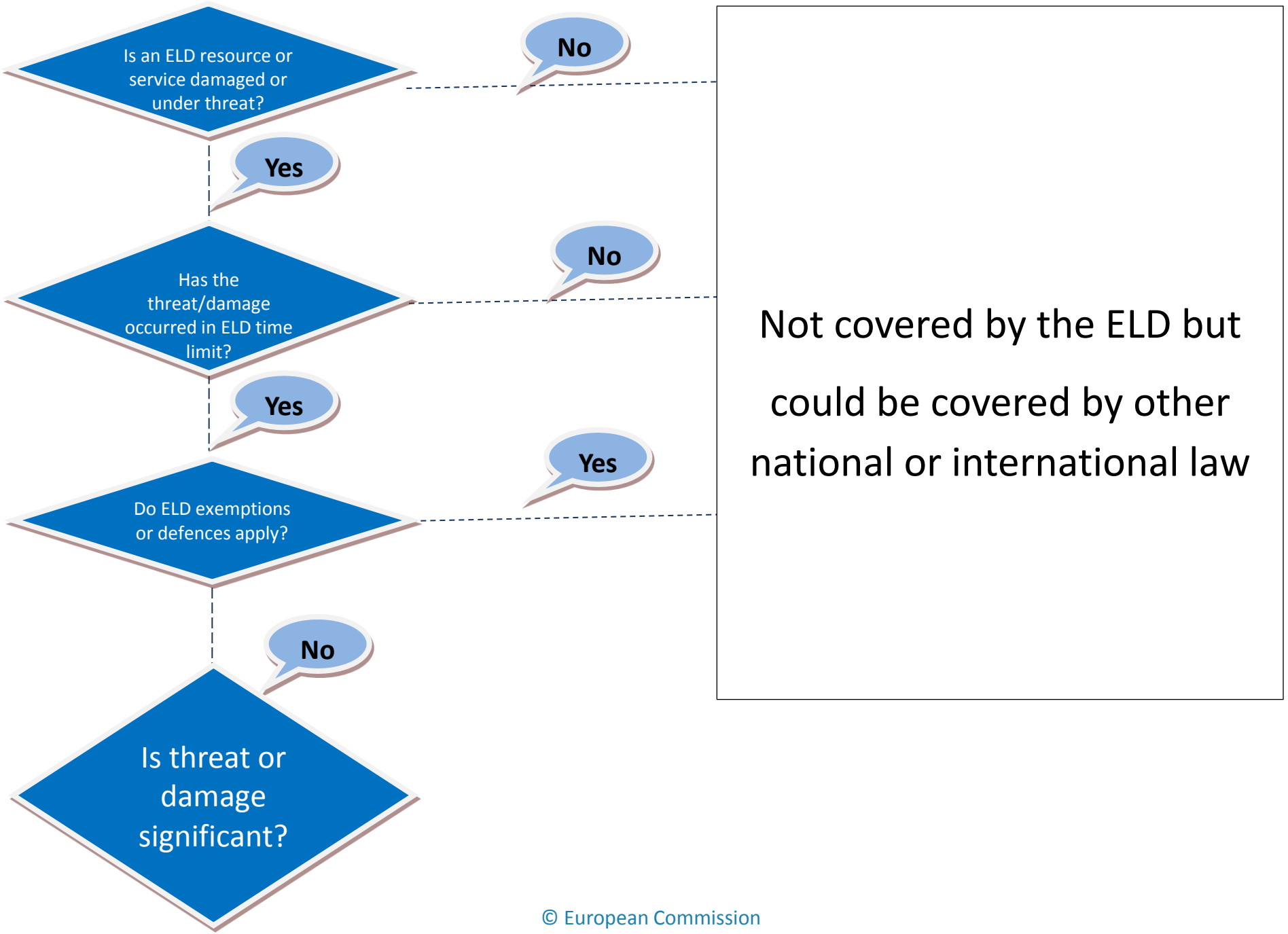
Permit Defence

- An emission or event expressly authorised by, and fully in accordance with, the conditions of an authorisation given under applicable national laws and regulations

State-of-the-Art Defence

- An emission or activity or any manner of using a product in the course of an activity which the operator demonstrates was not considered likely to cause environmental damage according to the state of scientific and technical knowledge at the time when the emission was released or the activity took place





Significant damage – general rules

- Case-specific
- Decided with reference to related directives and national legislation

Interpretations of *significance*

- Damage that is measurable and particularly "large" – large being case-specific

- Annex I criteria for biodiversity damage

General interpretations of *significance*

- Regulatory significance
- Social significance
- Biological significance
- Statistical significance

Who does What?
Post-incident

- Distinguish between
  - Once imminent threat is detected
  - Once environmental damage is detected
- Competent Authority and Operator: duty
- Financial security providers, experts: not a duty but a possible role
- Enabled persons: not a duty but a right

Who does What?
Post-incident

Competent Authority

- Determine whether the case is covered by the ELD
- If so, identify liable operator(s) and establish standard of liability
- Work with operator(s) to ensure remediation measures are undertaken
- Claim necessary costs from the operator(s) (if CA undertakes the remediation actions) (allocate costs in case of multi-party liability)
- Oversee the financial security instrument

Who does What?
Post-incident

Competent Authority

- Determine whether the case is covered by the ELD
- If so, identify liable operator(s) and establish type of liability
- Work with operator(s) to ensure preventative and remediation measures are undertaken
- Claim necessary costs from the operator(s) (if CA undertakes the remediation actions) (allocate costs in case of multi-party liability)
- Oversee the financial security instrument

Operator

- Take immediate steps to stop the incident, prevent further damage, repair the damage. Immediately report the damage or threat to the CA.
- Take steps to implement all necessary remediation, as directed by the CA.
- Pay relevant costs as required

Who does what?
Post-incident

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Financial Security Providers

- contribute to damage and remediation assessment

Who does What?
Post-incident

Competent Authority

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- If so, identify liable operator(s) and establish type of liability
- Work with operator(s) to ensure preventative and remediation measures are undertaken
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Operator

- Take immediate steps to stop the incident, prevent further damage, repair the damage. Immediately report the damage or threat to the CA.
- Immediately report the damage or threat to the CA.
- Take steps to implement (or fund) all necessary remediation, as directed by the CA.
- Pay relevant costs as required

Financial Security Providers

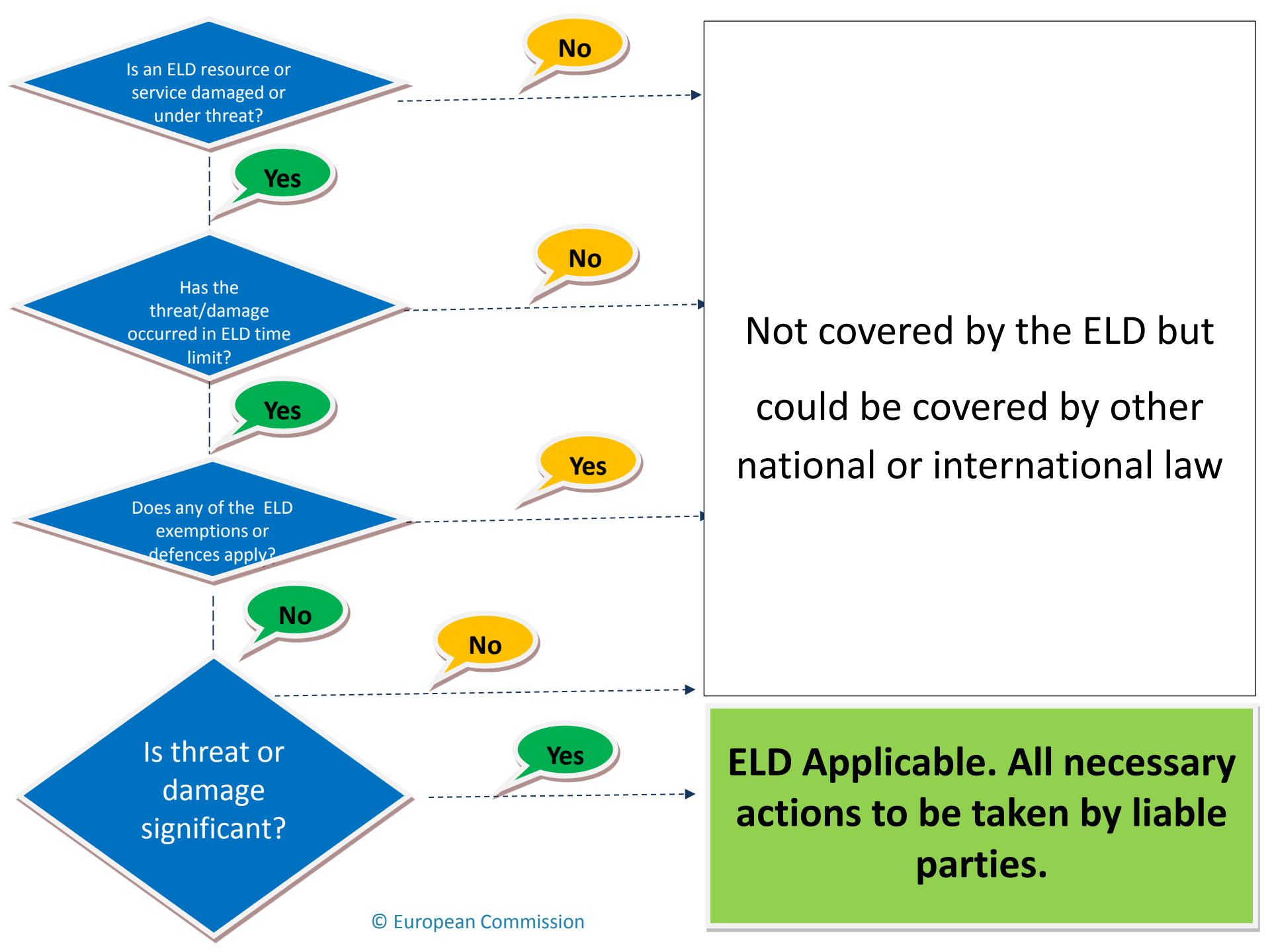
- contribute to damage and remediation assessment

Other Experts

- assess, review and oversight of imminent threat or damage assessment and remediation option selection, design and implementation
- monitor the outcomes

General implementation role for the Competent Authorities

- report the ELD experience to the Commission by 30 April 2013 at the latest
- may chose to set up a national reporting system and ELD case database



Costs and financing

Costs associated with environmental liabilities under ELD

- Costs of assessing environmental damage (or imminent threat of such damage), and the development and selection of remediation options
- Costs of data collection and analysis, other general costs, monitoring and supervision costs
- Administrative, legal, and enforcement costs
- All costs of implementing remediation

Implementation costs of remediation

- Design (including scientific or engineering design, permitting, surveying, sampling, and other related design costs)
- Land acquisition (if necessary)
- Implementation
- Operation and maintenance, including monitoring and adaptive management based on performance criteria
- Administration and necessary oversight by the Competent Authority
- Contingency for failure

Disproportionate Costs

- Certain costs of remediation may be considered to be “disporportionate” to damages
- Def: costs of remediation >>> benefits…BUT
  - Degree to which remediation costs > benefits undefined
    - the margin by which costs exceed benefits must be appreciable
  - Not limited to quantifiable costs and benefits
- Further work on this re Water Framework Directive

Financial Security

- Insurance (variations to General Third Party Liability or Environmental Impairment Liability policies);
- Bank guarantees, and
- Other Market Based Instruments (MBIs) such as funds, bonds, etc.

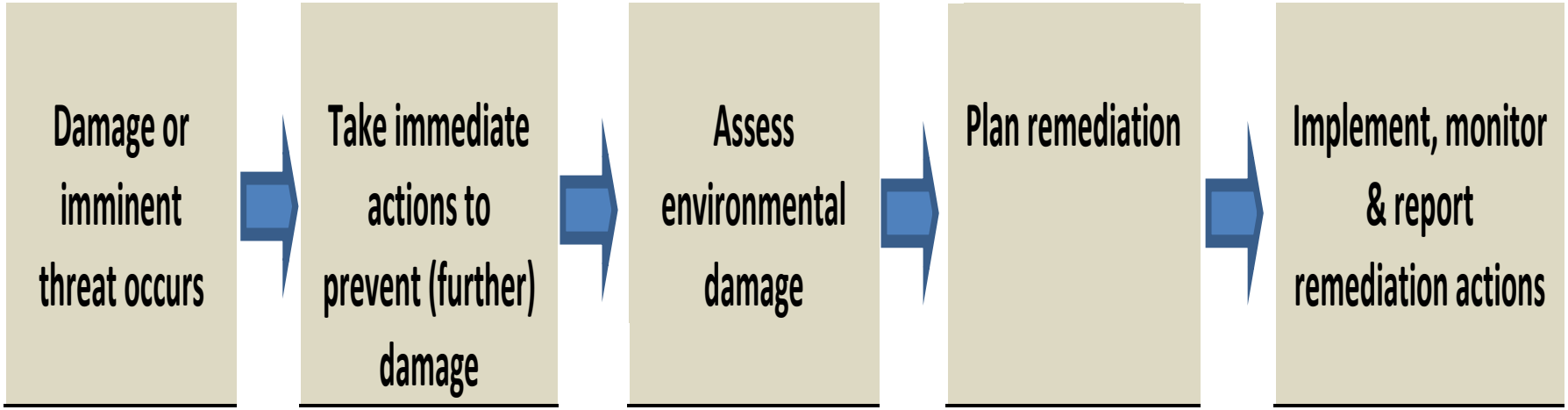
Member State Coverage according to the COM Report 2010

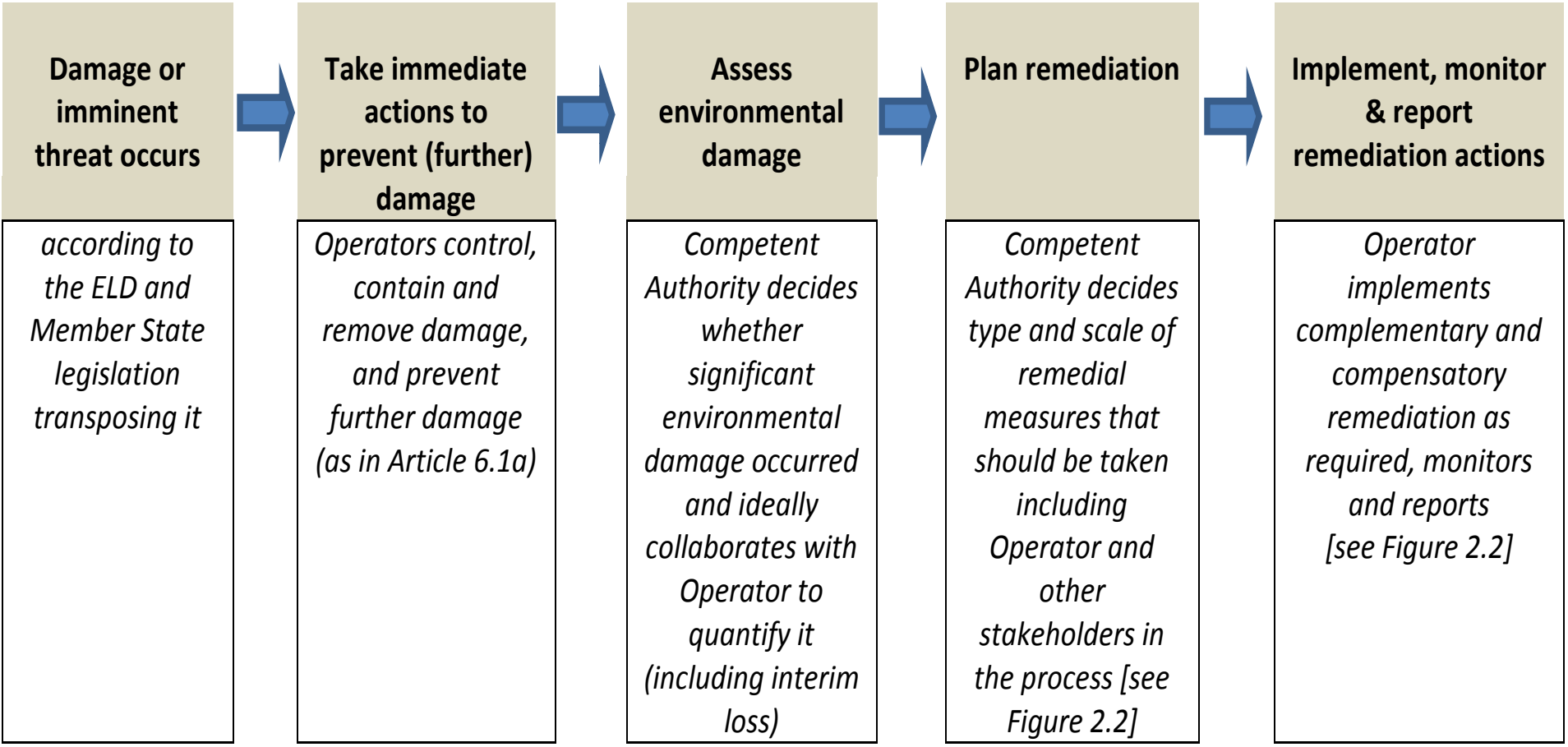
- Insurance: all MS
  - Diverse products by individual insurers or Insurance pools (Pools in Spain, France and Italy)
  - Different market penetration so far
- Bank guarantees:
  - Austria, Belgium, Cyprus, Czech Republic, the Netherlands, Poland, Spain and the UK
- Other MBIs being considered in:
  - Austria, Belgium, Bulgaria, Cyprus, Poland and Spain

Key future dates

- Reports by Member States on the implementation of ELD due on 30 April 2013
- European Commission report due 30 April 2014

Planning Remediation Actions





Primary Remediation

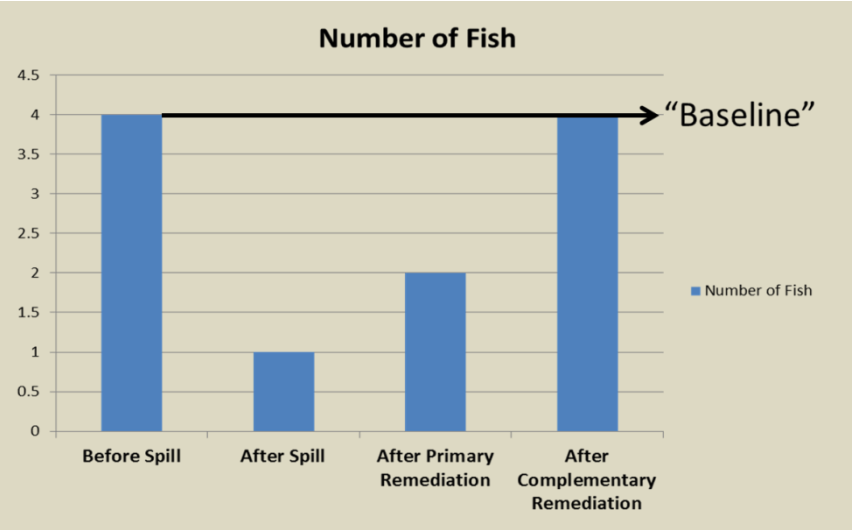
- Remedial measures should be designed to:
  - Cease, reduce, or otherwise abate ongoing damage ("emergency" remedial measures)
  - Return the damaged natural resources and/or impaired services to (or towards) baseline conditions ("actual" remedial measures)
- Natural recovery may be considered in addition to as direct intervention options

Complementary Remediation

- Required where primary remediation is not sufficient to return the resource or service to baseline conditions
- May be of the same or similar type of resource or service
- May be performed on and/or off damaged site

Interim Loss

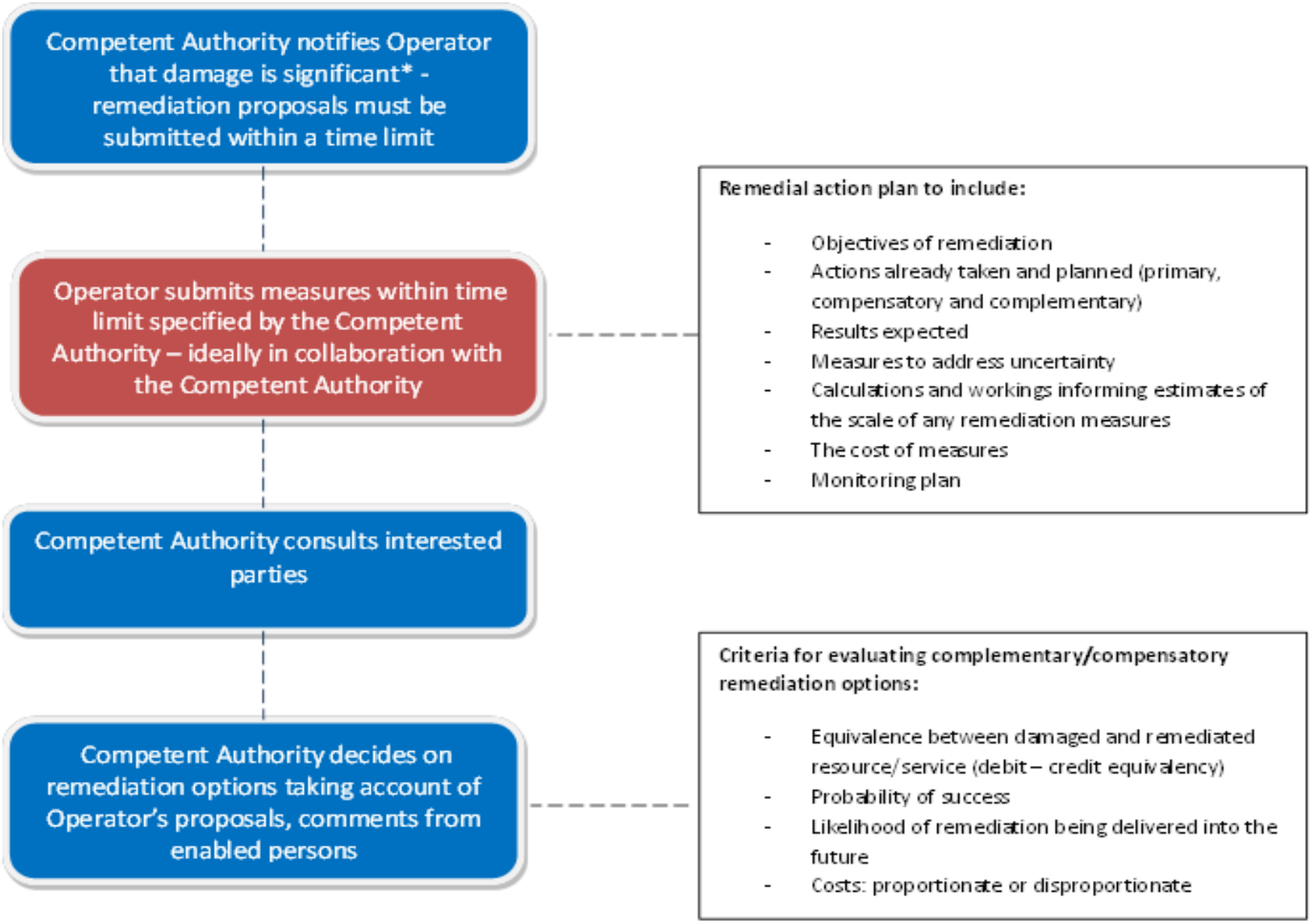
- Losses incurred from the onset of damage and the time when resources or services return to baseline



- If baseline is not reached, interim losses continue into perpetuity
- Requires separate compensation (compensatory remediation) that is in addition to primary or complementary remediation.

Compensatory Remediation

- Performed to compensate for interim losses
- Remediation can be to a different type of resource/service than the damaged resource/service
  - Resource equivalency methods used for this analysis
- Remediation can be implemented at a different location than the damaged site



European Commission

eftec

STRATUS CONSULTING

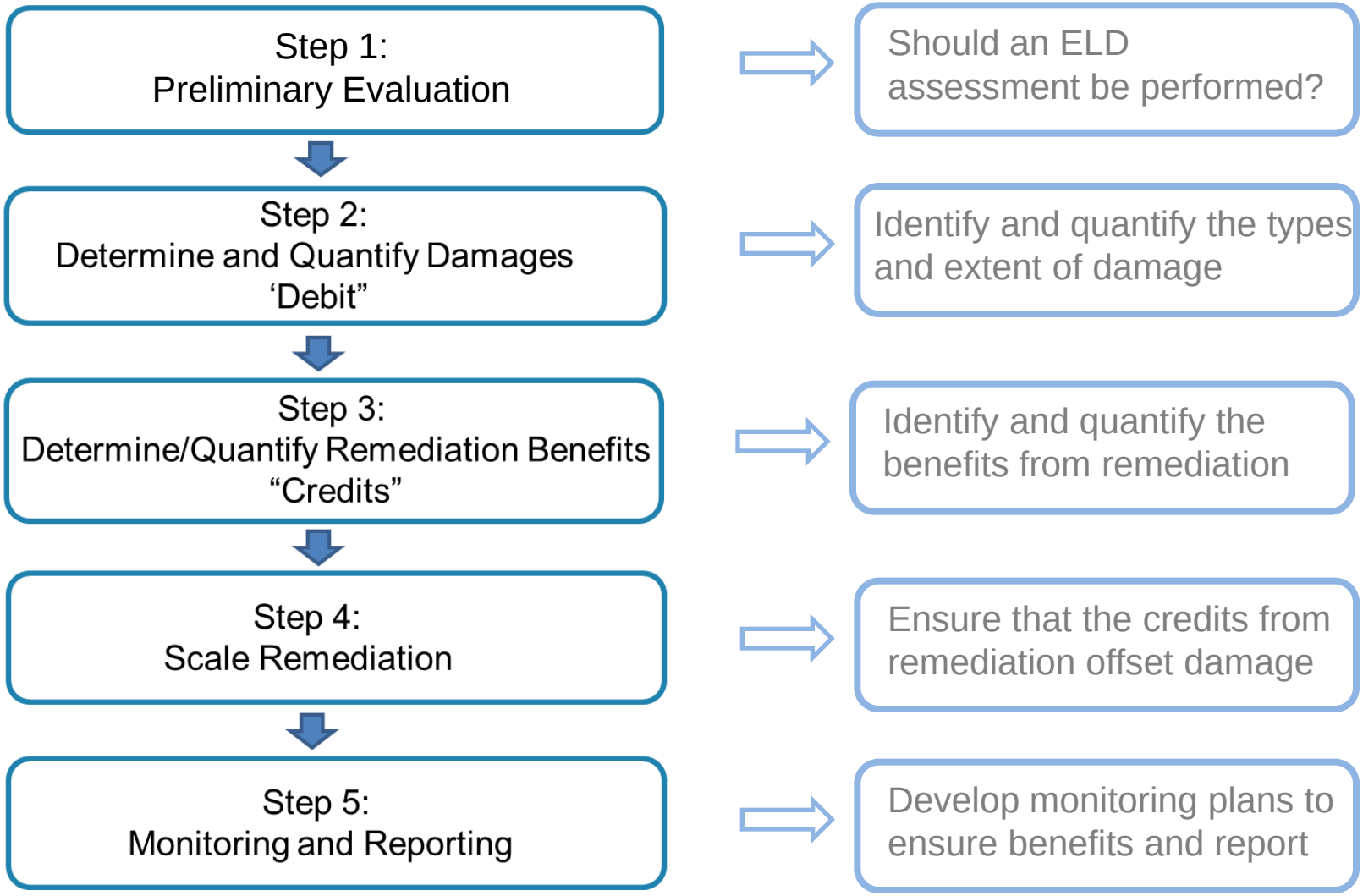
2 Days Training Session

ASSESSMENT APPROACHES

Outline

- Overall approach to an ELD assessment using a hypothetical case study
- Detailed discussion of equivalency analysis
- Discussion of small group exercise

The ELD Assessment Process

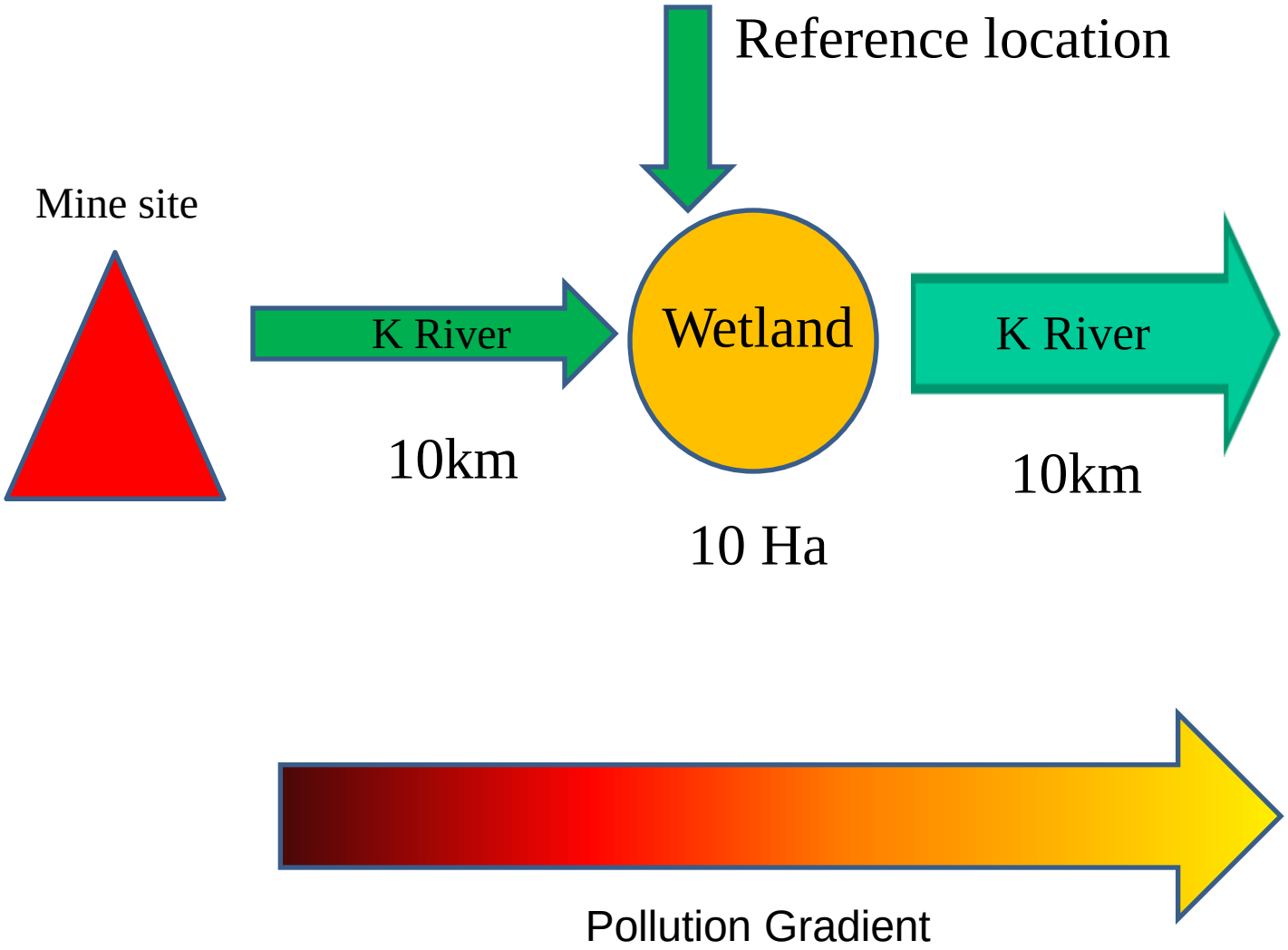


Case Study Scenario: Tailings Dam Failure in the “K Valley”

Case Study Overview

- Heavy metal mining (e.g., Cu, Zn, Pb) in “K Valley”
- Tailings disposed of in permitted holding ponds in watershed; retained by dam
- Heavy winter rain-on-snow: dam failure
- Tailings slurry discharged into K River, flows downstream into wetland
- Emergency responders succeed in repairing facility within 24h
- Contamination observed downstream for at least 10 km in K River, and throughout wetland

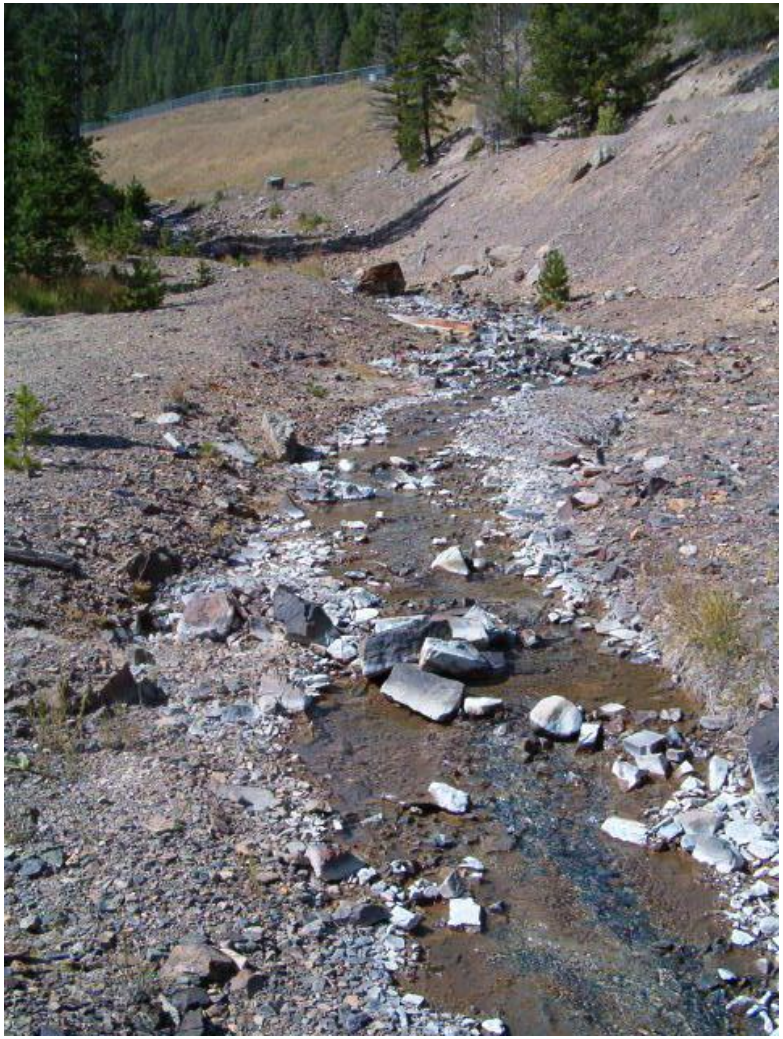
Site Layout

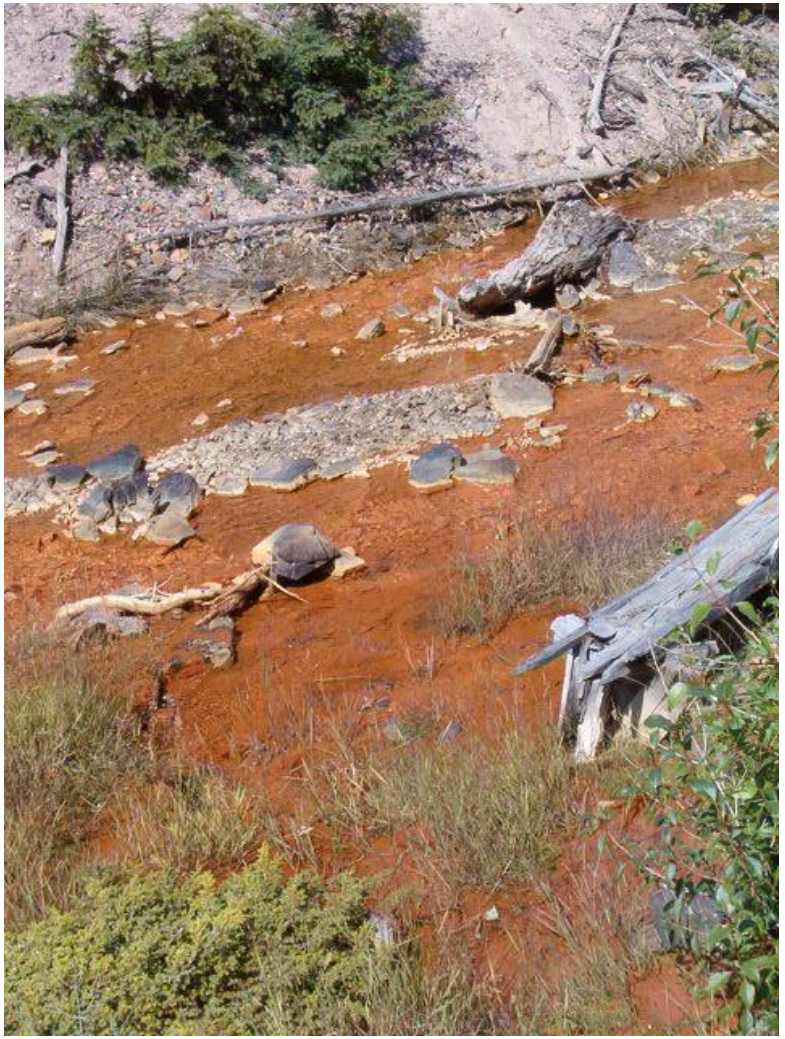

Reference location
Mine site
K River
Wetland
K River
10km
10km
10 Ha
Pollution Gradient

Incident: Discharges of Metals/Acid

Impacts to K Watershed

Impacts to K River Watershed





What Happens Next?

- Stop the ongoing pollution
- Study affected areas and remediate to extent practicable
- Study affected environment and remediate to baseline conditions
- Evaluation of supplemental “compensatory” remediation

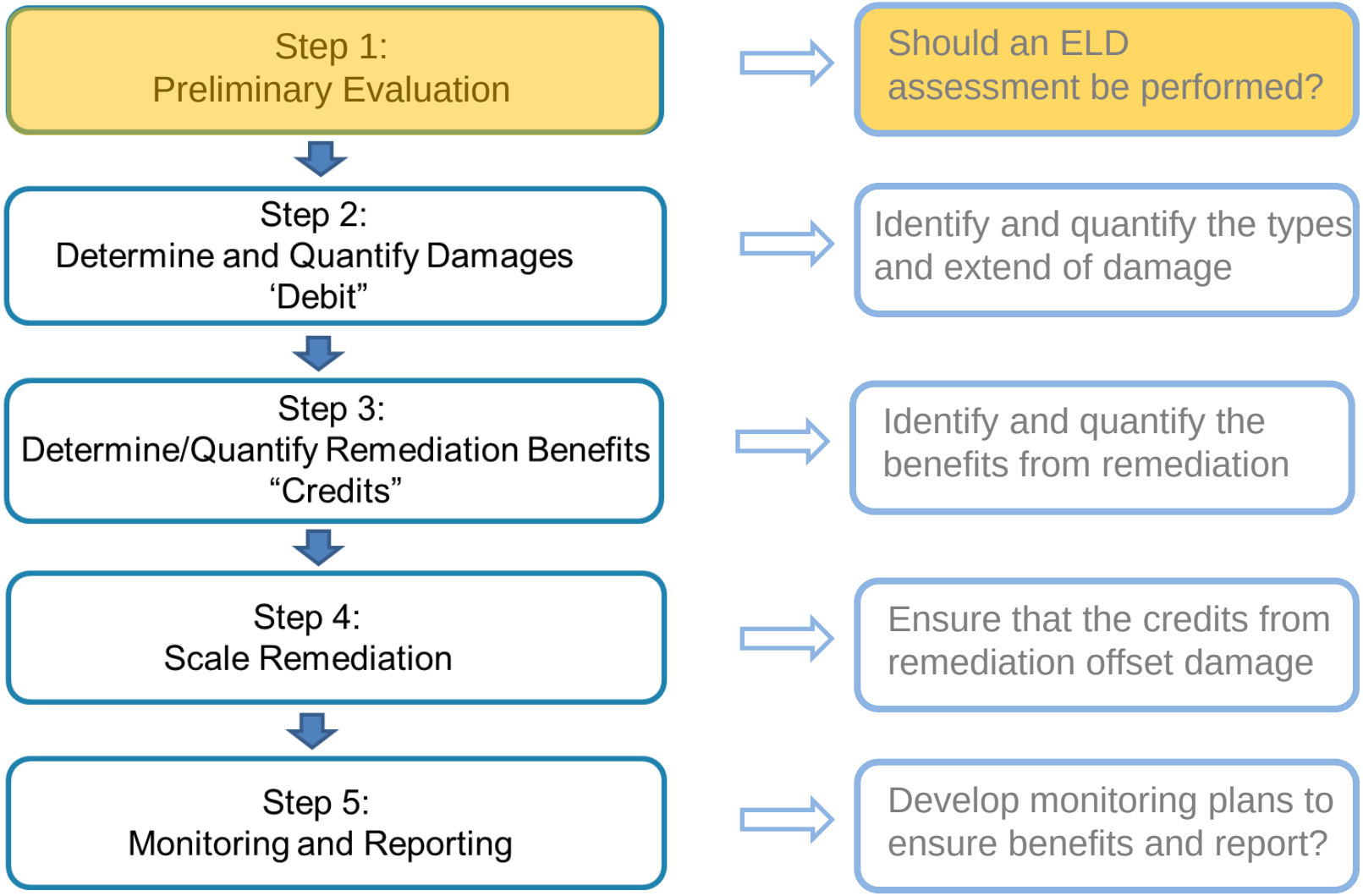
Emergency Response: Stop the Ongoing Pollution

- Dam Repair
  - To prevent additional contamination of the river and wetland
- Notification of the public not to eat fish
  - To prevent human health impacts
- Additional environmental assessment required!

Step 1: Preliminary Evaluation

- Purpose: to determine whether an equivalency analysis should be performed
  - Describe the incident
  - Identify and describe affected locations, environments , habitats and species
  - Identify the nature, degree, spatial and temporal extent of environmental damage incurred or anticipated
  - Evaluate benefits of primary remediation
  - Begin evaluation of additional assessment actions and potential need for complementary or compensatory remediation actions
  - Determine if an ELD assessment should be conducted and the appropriate scale of the assessment

The ELD Assessment Process



Step 1: Preliminary Evaluation

Key Questions to Answer in the Initial Evaluation

Who is the operator(s)?

What was released?

Are damages likely to be significant (to be determined by the Member States) but likely including considerations about extent, severity and duration of damage)?

Will primary remediation fully compensate for environmental damage?

Would complementary or compensatory remediation be needed to offset losses?

Are services to human likely to have been affected by the damage?

What is the appropriate level of detail of the assessment?

Preliminary Evaluation

- Sources of initial information:
  - Site visit
  - Discussions with on-site response personnel
  - Interviews with local resource managers
  - Interviews with operators
  - Previous assessments
  - Review of existing data / online databases

Preliminary Evaluation

- Description of the incident
  - Who is the responsible operator?
  - What and how much was released?
  - When and for how long was it released?
  - What are emergency response / clean up actions?
  - What primary remediation is anticipated?

Preliminary Evaluation

- Identification and description of affected locations, environments, habitats and species
  - What resources and habitats were exposed?
  - What services might have been affected?
  - How long will exposure last?
  - What was the physical, biological and chemical quality of the affected natural resources?

Preliminary Evaluation

- Identification and description of nature, degree, spatial and temporal extent of damage
  - Have resources been exposed?
  - What habitats, communities and species are likely to be at greatest risk?
  - Is there direct evidence of damage (e.g., fish kills)?
  - What is nature of potential damage (mortality, habitat loss, sub-lethal effects)?
  - How spatially widespread is potential damage?
  - How long might damage persist?

Preliminary Evaluation

- Data sources to identify and describe the nature, degree, spatial and temporal extent of damage
  - Data on community ecology relevant to food-chain transfer
  - Mapping, tracking, and imagery
  - Samples of materials that might disperse dissipate, degrade etc.
  - Supporting environmental data
  - Collection of carcasses or other data
  - Available baseline data.

K Valley: Preliminary Evaluation

- Incident consisted of a single tailings release of short duration (less than 2 d); however, the discharged tailings pose a long-term hazard to the environment.
- The tailings contained very high concentrations of heavy metals (e.g., copper, zinc, and cadmium) and were somewhat acidic (pH 4).
- Flow rates in the river were very elevated relative to typical winter flows.
- Emergency response actions resulted in rapid repairs being made to the tailings dam. All mineral processing activities suspended during the repair period. No emergency actions were taken for the river or wetland.
- Photographs were taken documenting the incident, and the facility collected several samples of river water in the 10km stream upstream of the wetland. No samples were collected in the wetland or in the river downstream of the wetland.

K Valley: Preliminary Evaluation

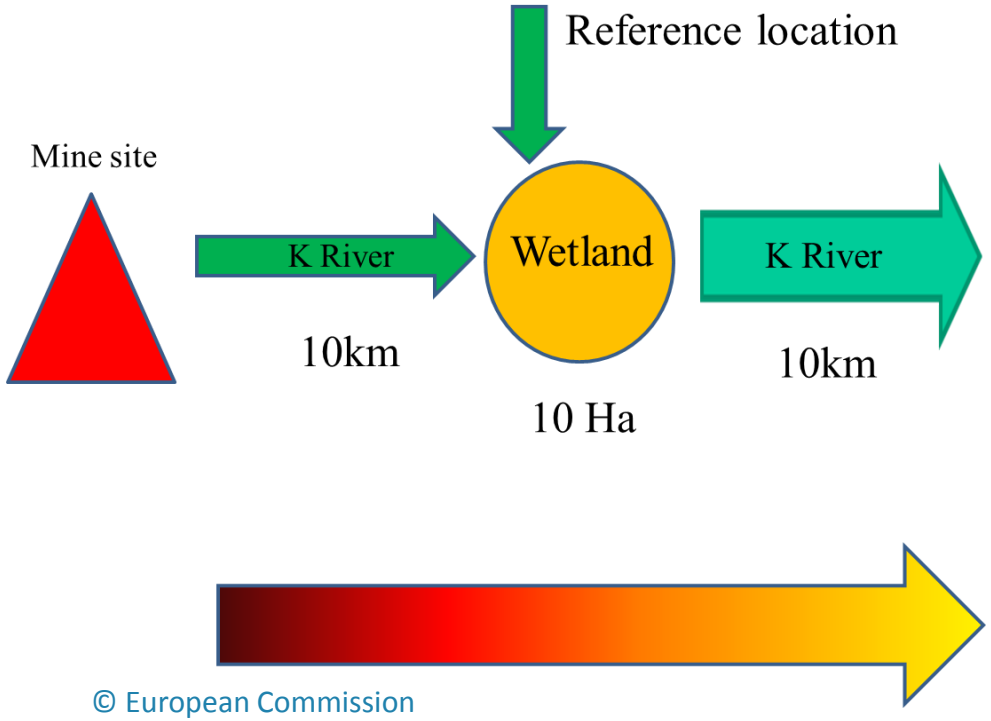
- Reports of brown trout carcasses being seen along the river banks; no systematic sampling.
- Pre-incident water quality data for the river were obtained. No baseline biological data were found.

Preliminary Evaluation: Potentially Affected Resources

- Preliminary identification of potentially affected resources undertaken based on interviews with resource managers, review of published information for this and similar locations, discussions with the facility operator, site visits, and review of photographs. Potentially affected resources included the following:
  - Water quality in the river and wetland.
  - Sediment quality in the river and wetland.
  - Riverine, riparian, and wetland habitats.
  - Aquatic biota, particularly brown trout and aquatic invertebrates.
  - Wetland vegetation
  - Small mammals and migratory birds that potentially utilize wetland habitats during summer months

K Valley: Potentially Affected Resources?

- Potentially affected locations included the upper 10 km of the K river, the wetland, and an unknown length of the river downstream of the wetland.



K Valley: Preliminary Evaluation: Preliminary Identification of Services

- Potentially affected services:
  - Riverine, riparian, and wetland habitat services
  - Other ecological services associated with affected habitats and biota
  - Recreational fishing and fish consumption
  - No drinking water uses

K Valley: Potentially Affected Services?

- River is a location where residents go to fish

- Nearby residents do not use the river for drinking water and the morphology of the valley greatly limits the amount of alluvial groundwater. Consequently, groundwater and drinking water services were not deemed to be at risk.

K Valley: Preliminary Evaluation: Social, Economic or Transboundary Issues?

- None

K Valley: Primary Remediation Evaluation

- The emergency response undertaken by the facility was successful in preventing ongoing tailings discharges
- Additional primary remediation of the wetland to remove deposited tailings might be feasible, but would require study to evaluate likely benefits and potential collateral impacts.
- Because of the nature of the mine tailings, the duration of future impacts is likely to be sufficiently long that interim losses will occur prior to any recovery to baseline.

Preliminary Evaluation

- Preliminary, complementary and compensatory remediation planning
  - Are there options for complementary and compensatory remediation that provide resources or services that are sufficiently similar to the lost resources and services to enable equivalency analysis?
  - Is it possible to identify the units of exchange and metrics that will be used? This would enable early collection of data.
  - What information is available about key receptors, likely magnitude of impact, recovery time, reasonable remediation alternatives and costs?
  - What additional information is being collected during response and primary remediation efforts that could be used to determine the amount of complementary or compensatory remediation necessary?

Preliminary Evaluation

- Scaling complementary or compensatory remediation
  - Resource-to-resource (REA) or service-to-service (HEA) equivalency approaches shall be considered first.
  - If REA or HEA not possible, then alternative valuation methods shall be used.
    - Value-to-Value or Value-to-Cost

Preliminary Evaluation

- Scaling complementary or compensatory remediation
  - Requires that a common metric can be used between damaged resource/services and remediated resources/services
  - Incorporated the landscape and social context between damage site and remediated sites
  - Accounts for time differences between when damage occurs an remediation benefits begin
  - Incorporated the degree of damage
  - Accounts for differences in the types of resources/services damaged and remediated

K Valley: Preliminary Remediation Evaluation?

- Habitat and/or resource equivalency are appropriate approaches to evaluate the amount of complementary and compensatory remediation necessary to offset to affected injuries to biota and habitats.
- Compensatory remediation of wetlands, river habitats, and brown trout is likely feasible. Ecological restoration projects focused on these resources have been implemented elsewhere.
- Additional assessment for recreation?

K Valley: Preliminary Evaluation: Defining Scope of Assessment

- Competent Authority/operator concluded that a full assessment of damages was required. This conclusion was based on the following:
  - Incident within the scope of the ELD
  - Damages likely significant and ongoing; will not recover naturally in a short period of time.

Why is K Valley a “Significant” Incident?

- Competent Authority/operator concluded that impacts to river and wetlands would last a long time
- Wetland habitats would not recover naturally without some primary remediation
- Large loss of fish to an important river
- Important recreational fishing area
- Public was very interested in seeing that something was done to remediate the damages

K Valley: Scope of Assessment

- Based on the foregoing, the Competent Authority/Operator determined that a full assessment should be undertaken, including collection of site-specific data and development of appropriate remediation and monitoring plans. The likely duration of such an assessment might be on the order of 1-3 years

K Valley: Scope of Assessment?

- Available site-specific data, including chemical and biological information, was not sufficient to quantify damages. However, such data could feasibly and realistically be collected. For example, studies on water quality, sediment quality, trout populations, and wetland health are commonly performed using well-documented methods.

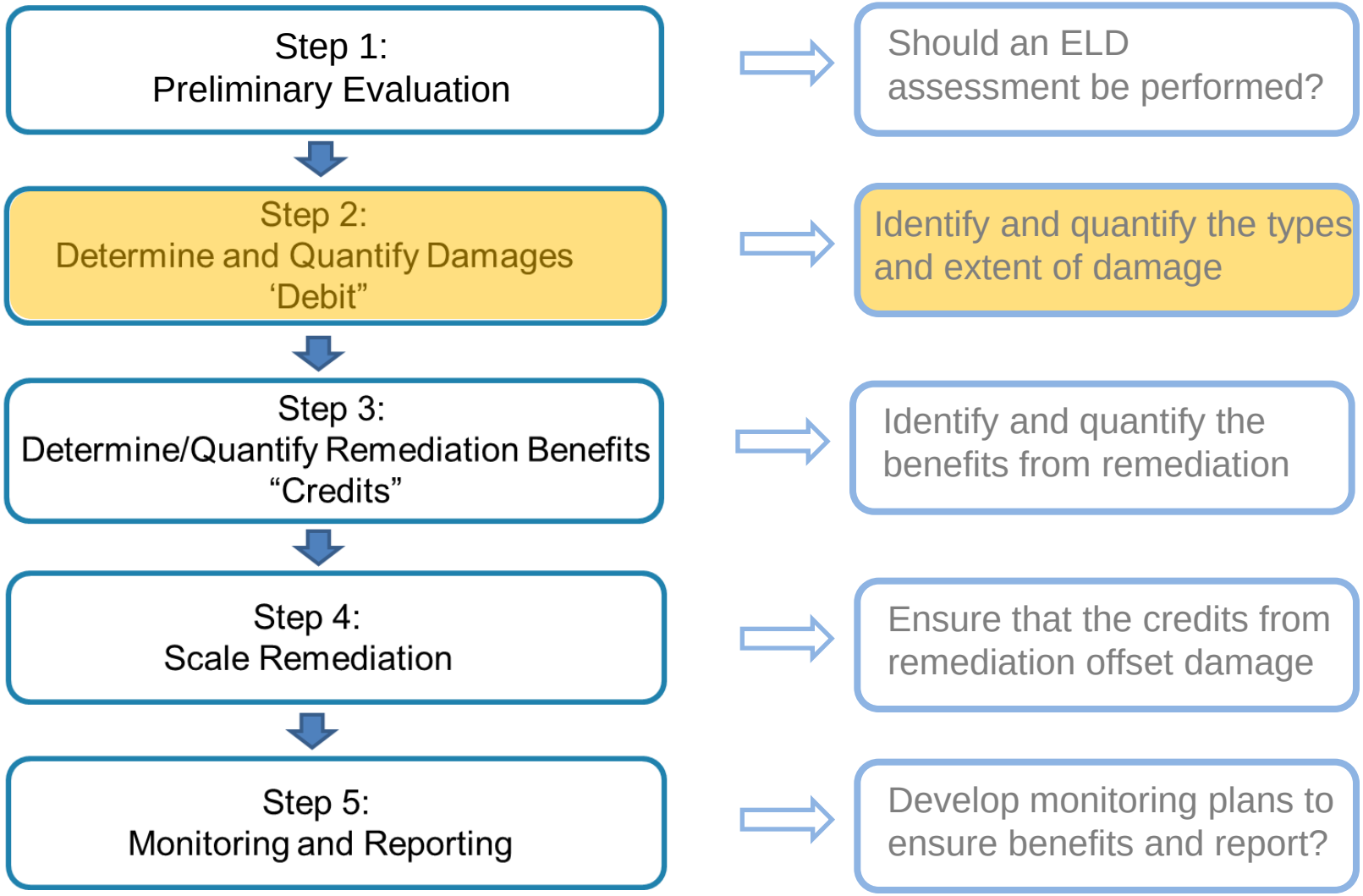
- Primary remediation will not result in full recovery to baseline conditions and would not compensate the public for anticipated future interim losses. Complementary and compensatory remediation projects for the types of resources potentially affected by the incident are feasible.

K Valley: Scope of the Assessment

- Specific assessments categories:
  - River resources
  - Wetlands
  - Recreational fishing losses

- The likely duration of such an assessment might be on the order of 1-3 years

The ELD Assessment Process

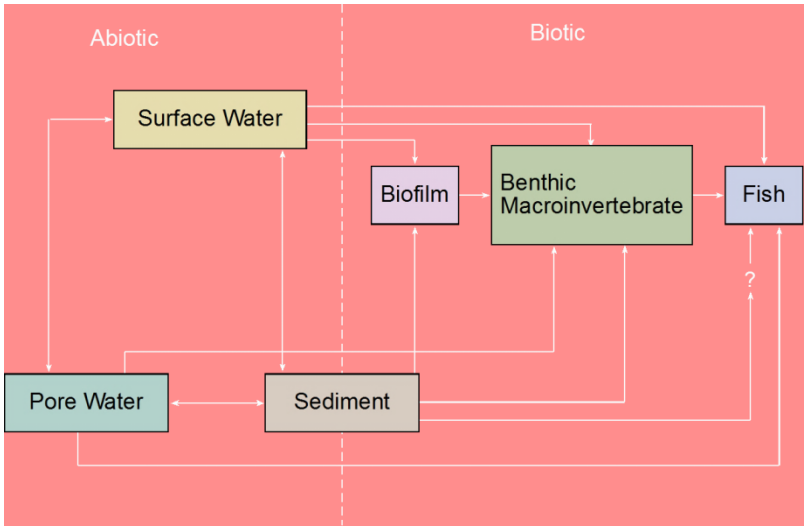


Step 2:
Determine and Quantify the Damage

- Identify the types of habitats, biota, or resource services that have been damaged
- Determine the cause of damage
- Quantifying damage by comparing pre- and post-resource/service levels to baseline conditions
- Determine the duration of the damage, interim loss and total debits

Determining Damage to Natural Resources ("Debit")

- In undertaking the damage determination, a site conceptual model of exposure and effects can be developed. This conceptual model helps guide the development of data collection.



Determining Damage to Natural Resources ("Debit")

- Types of data typically evaluated:
  - Site hydrology, geology, biogeochemistry
  - Presence of protected species and habitats
  - Types of water bodies affected
  - Special site designations (protected status?)
  - Chemical concentrations in soil, surface water, groundwater, biota and air.
  - Background concentrations of contaminates
  - Transport/exposure pathways

Determining Damage to Natural Resources ("Debit") (cont'd)

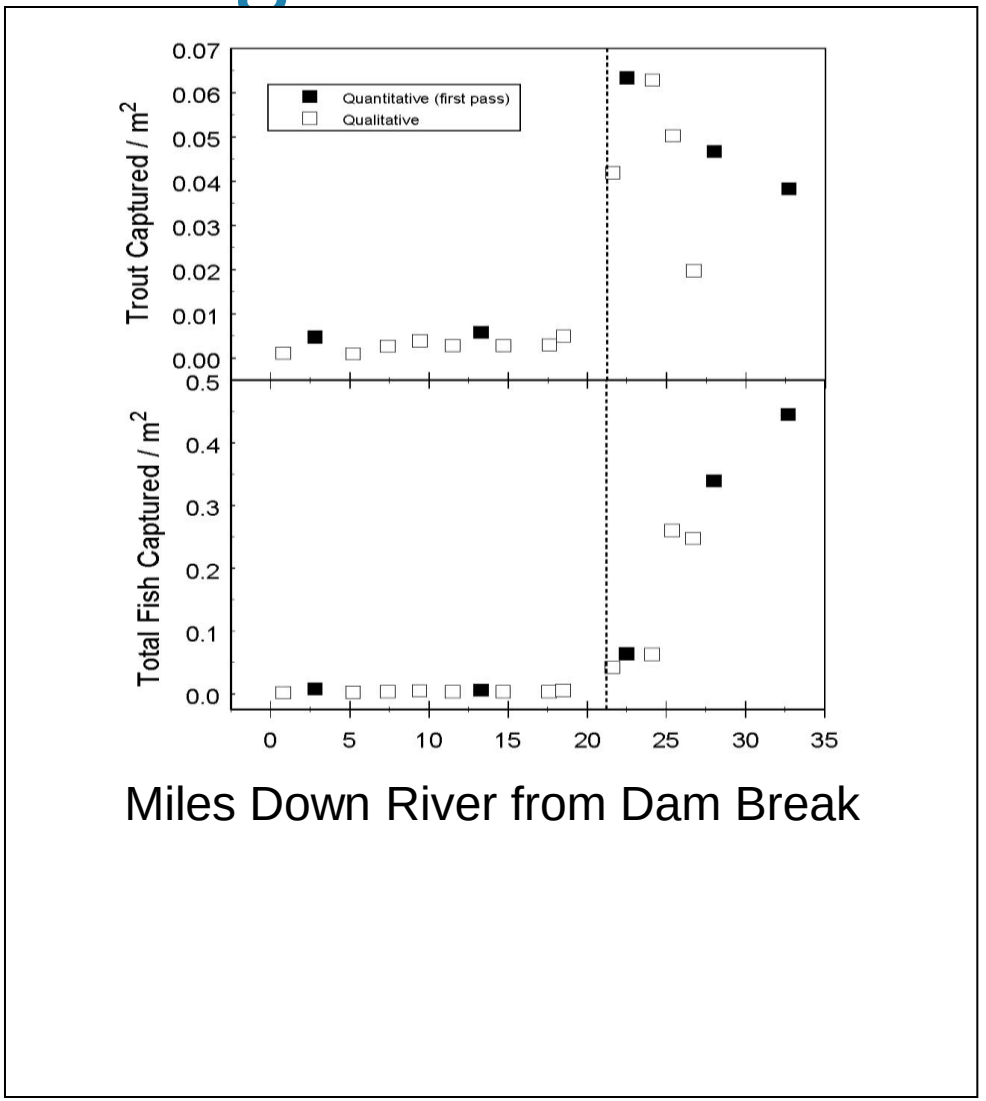
- Types of data typically evaluated:
  - Physical features of ecosystem and special vulnerabilities
  - Potentially affected species/habitats
  - Important habitat features and uses
  - Geographic proximity to population centers
  - Recreational and other uses of the resources
  - Important cultural/social status of resources

K Valley: Debit Analysis: River - Field Sampling

- Water quality samples in the river and wetland to measure concentrations of heavy metals.
- Sediment samples in the river and wetland.
- Collection of benthic macroinvertebrate samples to evaluate abundance and diversity.
- Studies to quantify brown trout abundance at a number of stations in the initial 10km upstream of the wetland, as well as for 20 km downstream of the wetland.

K Valley: Calculating the River Damage

Sampling determined the number of trout in affected areas relative to baseline conditions.



K Valley: Debit Analysis: Wetland Field Sampling

- Wetland vegetation surveys
- Migratory bird surveys in the wetland area during the summer months
- Aerial photography to aid in impacts quantification

K Valley: Debit Analysis: Findings

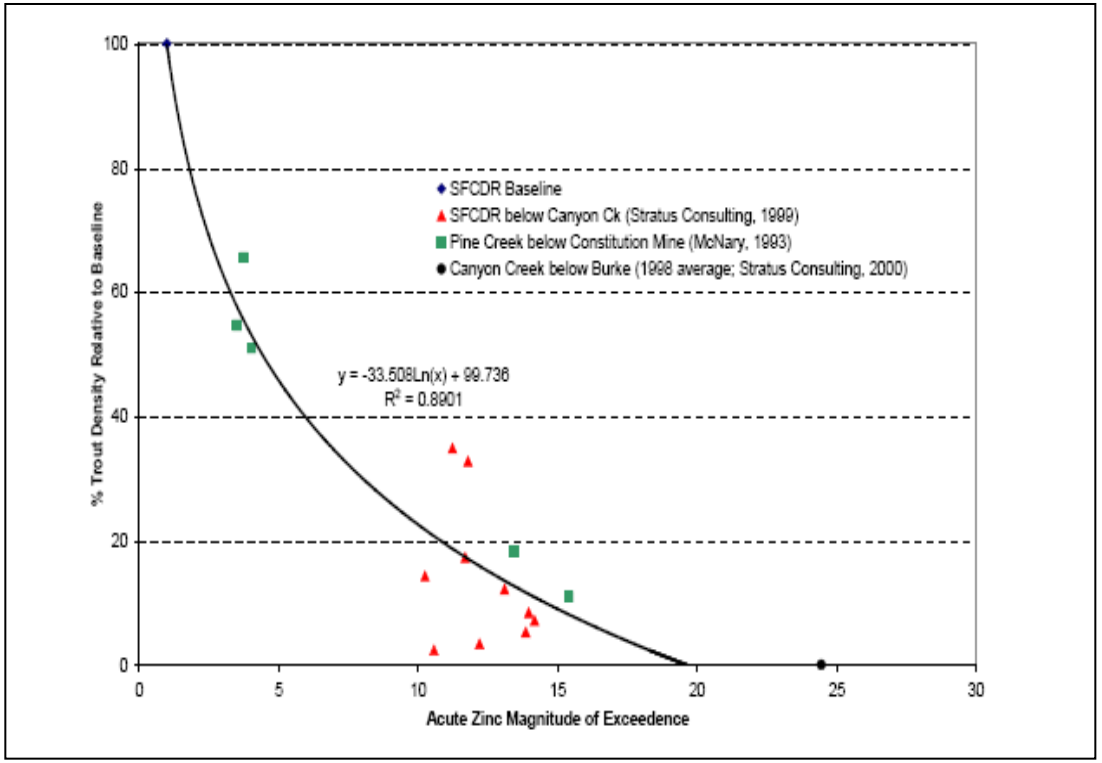
- Water quality throughout the upper 10km of the river exceeded regulatory criteria and literature-published toxicological effects thresholds.
- Exceedences in the first year following the spill were continuous and severe (more than 100 times the relevant criteria). In the second year following the spill, these exceedences continued but were less severe (10 times criteria). In the third year, concentrations were again somewhat lower. Simplified water quality modelling indicated a return to baseline conditions (no exceedences) by 5 years after the incident.
- Similar impairments were observed in sediments in the upper 10km of the river.

K Valley: Debit Analysis: Findings

- Trout and benthic invertebrates were completely eliminated from the river within the upper reach in the first year after the spill. Projected recovery times were estimated to be 10 years.
- Water quality downstream of the wetland was impaired for cadmium and zinc for at least 10 km. The degree of impairment was lower than upstream (approximately 5-10 times criteria and published thresholds), with full recovery expected within 5 years.
- Trout populations downstream of the wetland were approximately 50% of expected levels (based on downstream abundance data and data collected at reference sites) in the first 5km. By 10km downstream of the wetland, trout abundance appeared to be at normal baseline levels.

K Valley: Calculating Future Damage

Recovery rates based on relationship between zinc concentration and trout population



Defining “baseline”

- “the condition at the time of the damage of the natural resources and services that would have existed had the damage not occurred, estimated on the basis of the best information available”.

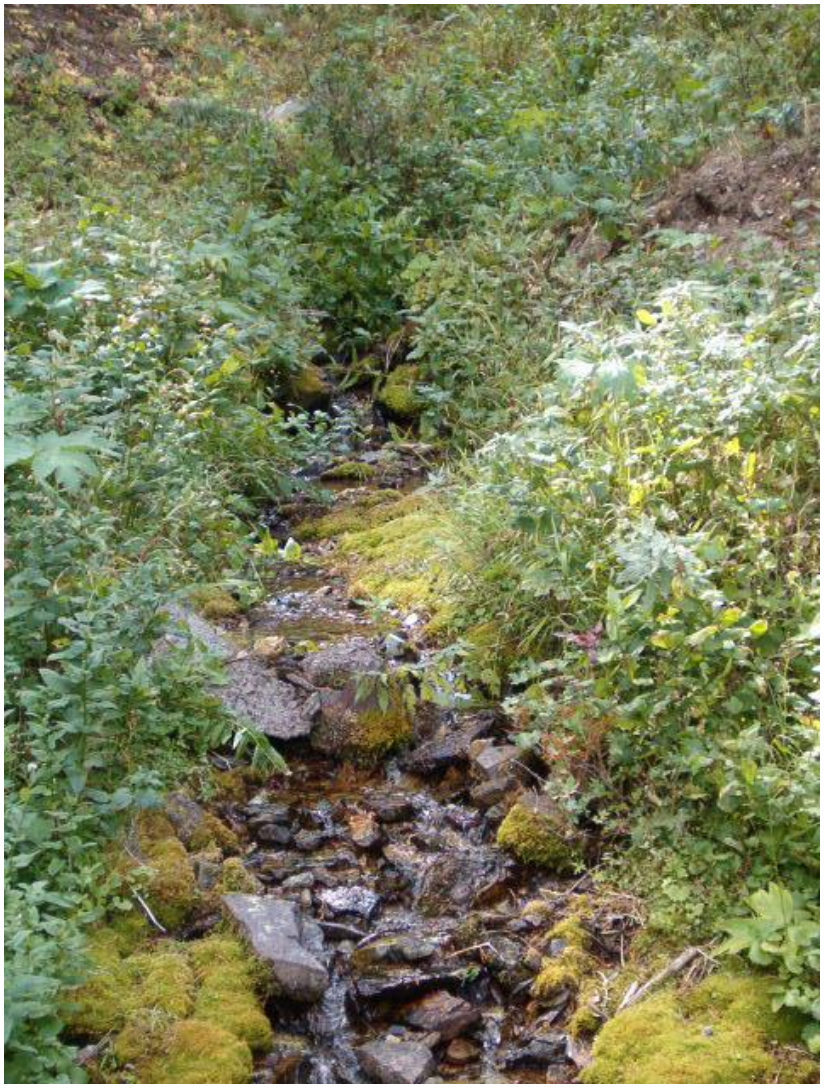
Determining baseline

- Natural fluctuations and or other (natural) causes to be taken into account?
  - Yes, it is not a penal law regime.
- Services: functions performed by a natural resource for the benefit of another natural resource or the *public*

Measuring baseline

- Site data
- Similar (reference) site data
- Modelling
- In many instances, quantifying damages in terms of an **incremental loss** relative to a remediation target, without explicit quantification of baseline conditions, is sufficient for an equivalency analysis

K Valley:
Observed Baseline at Reference Sites in Area



K Valley:
Reference (baseline) Wetland

Quantifying the Debit - Metrics

- Debits are quantified using “metrics” to describe changes in resources or resource services
- Common metrics must be used for both “debit” and “credit” side of analysis

Example Metrics

- Area of devegetated terrestrial habitat (ha)
- Area of habitat (terrestrial, aquatic) in which contaminant concentrations exceed toxicological thresholds (ha, km of stream)
- Fish density (number per m^2)
- Fish biomass (kg)
- Bird production (lost bird years)
- Number of days of lost recreation

K Valley: Damage Quantification- River Resources

- Damages to river resources were quantified using the following metrics:
  - To quantify aquatic resource damages, brown trout abundance = key indicator metric for future use in a resource equivalency analysis.
  - Based on sampling at reference locations and downstream in the K river, baseline brown trout density was concluded to be 10 trout per 100 m2.
- Resource to Resource equivalency method chosen as assessment approach

K Valley: Damage Quantification- River Resources

- Upstream of Wetland:
  - 10km of river about 10 m wide = 100 000 m2
  - brown trout were eliminated in year 1, with an estimated recovery to baseline in 10 years.

- Downstream of Wetland:
  - 10km reach about 20 m wide = 200 000 m2
  - Brown trout density averaged 5 fish per 100 m2 after the spill, with an estimated recovery period of 5 years.

K River Injury (Debit) Inputs

2011	Injury Start Year
2012	Base Year
3%	Discount Rate

UPSTREAM INJURY

10	Upstream injured river length (km)
10	Mean river width over upstream injury area (m)
10	Baseline density of Brown Trout (#/100 sq m)
100%	Initial Resource Loss (percent)
10,000	Initial resource loss (# fish)
0%	Final Resource Loss (percent)
10	Years to recovery

DOWNSTREAM INJURY

10	Downstream injured river length (km)
20	Mean river width over downstream injury area (m)
10	Baseline density of Brown Trout (#/100 sq m)
50%	Initial Resource Loss (percent)
10,000	Initial resource loss (# fish)
0%	Final Resource Loss (percent)
5	Years to recovery

K River
Example Brown Trout Loss Calculation

Year	Discount Factor	Annual Resource loss Upstream of Wetland Injury (Percent)	Annual Resource loss Upstream of Wetland Injury (# Fish/year)	Annual Resource loss Downstream of Wetland Injury (Percent)	Annual Resource loss Downstream of Wetland Injury (# Fish/year)	DISCOUNTED Annual Resource loss Upstream of Wetland Injury (# Fish/year)	DISCOUNTED Annual Resource loss Downstream of Wetland Injury (# Fish/year)	TOTAL DISCOUNTED Annual Resource Loss (# Fish/year)	TOTAL DISCOUNTED FISH YEARS LOST
2011	1.03	100%	10,000	50%	10,000	10,300	10,300	20,600	81,703
2012	1.00	90%	9,000	40%	8,000	9,000	8,000	17,000	
2013	0.97	80%	8,000	30%	6,000	7,767	5,825	13,592	
2014	0.94	70%	7,000	20%	4,000	6,598	3,770	10,369	
2015	0.92	60%	6,000	10%	2,000	5,491	1,830	7,321	
2016	0.89	50%	5,000	0%	0	4,442	0	4,442	
2017	0.86	40%	4,000	0%	-	3,450	-	3,450	
2018	0.84	30%	3,000	0%	-	2,512	-	2,512	
2019	0.81	20%	2,000	0%	-	1,626	-	1,626	
2020	0.79	10%	1,000	0%	-	789	-	789	
2021	0.77	0%	0	0%	-	0	-	0	

K River

Example Brown Trout Loss Calculation

Year	Discount Factor	Annual Resource loss Upstream of Wetland Injury (Percent)	Annual Resource loss Upstream of Wetland Injury (# Fish/year)	Annual Resource loss Downstream of Wetland Injury (Percent)	Annual Resource loss Downstream of Wetland Injury (# Fish/year)	DISCOUNTED Annual Resource loss Upstream of Wetland Injury (# Fish/year)	DISCOUNTED Annual Resource loss Downstream of Wetland Injury (# Fish/year)	TOTAL DISCOUNTED Annual Resource Loss (# Fish/year)	TOTAL DISCOUNTED FISH YEARS LOST
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2015	0.92	60%	6,000	10%	2,000	5,491	1,830	7,321	
2016	0.89	50%	5,000	0%	0	4,442	0	4,442	
2017	0.86	40%	4,000	0%	-	3,450	-	3,450	
2018	0.84	30%	3,000	0%	-	2,512	-	2,512	
2019	0.81	20%	2,000	0%	-	1,626	-	1,626	
2020	0.79	10%	1,000	0%	-	789	-	789	
2021	0.77	0%	0	0%	-	0	-	0	

K River
Example Brown Trout Loss Calculation

Year	Discount Factor	Annual Resource loss Upstream of Wetland Injury (Percent)	Annual Resource loss Upstream of Wetland Injury (# Fish/year)	Annual Resource loss Downstream of Wetland Injury (Percent)	Annual Resource loss Downstream of Wetland Injury (# Fish/year)	DISCOUNTED Annual Resource loss Upstream of Wetland Injury (# Fish/year)	DISCOUNTED Annual Resource loss Downstream of Wetland Injury (# Fish/year)	TOTAL DISCOUNTED Annual Resource Loss (# Fish/year)	TOTAL DISCOUNTED FISH YEARS LOST
2011	1.03	100%	10,000	50%	10,000	10,300	10,300	20,600	81,703
2012	1.00	90%	9,000	40%	8,000	9,000	8,000	17,000	
2013	0.97	80%	8,000	30%	6,000	7,767	5,825	13,592	
2014	0.94	70%	7,000	20%	4,000	6,598	3,770	10,369	
2015	0.92	60%	6,000	10%	2,000	5,491	1,830	7,321	
2016	0.89	50%	5,000	0%	0	4,442	0	4,442	
2017	0.86	40%	4,000	0%	-	3,450	-	3,450	
2018	0.84	30%	3,000	0%	-	2,512	-	2,512	
2019	0.81	20%	2,000	0%	-	1,626	-	1,626	
2020	0.79	10%	1,000	0%	-	789	-	789	
2021	0.77	0%	0	0%	-	0	-	0	

K River
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K River
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K Valley Damages Quantification- Recreational Fishing

- 15 KM of River are a popular trout fishery
- Because of the release, this area is closed to fishing for five years
  - Because of potential contamination
  - To allow fish populations to recover
- Information about the amount of fishing in this area is available from license sales
- Lost about 5 000 fishing trips per year
  - Metric is “fishing trips”

K Valley: Example Recreational Fishing Loss Calculation - Debit

RECREATIONAL FISHING

15 Area of damaged habitat (km)

100% Initial Service Loss (percent)

2015 Year Recovery of damaged occurs

2 Years until full recovery is reached

0% Resource Loss (percent) at end recovery

Year	Discount Factor	Annual Recreational Service Loss (Percent)	Annual Recreational Service Loss (# trips/year)	DISCOUNTED Annual Recreational Service Loss (# trip- years)	TOTAL DISCOUNTED Recreational Service Loss Trip Years Lost
2011	1.03	1.00	2400	2472	12 732
2012	1.00	1.00	2400	2400	
2013	0.97	1.00	2400	2328	
2014	0.94	1.00	2400	2256	
2015	0.92	1.00	2400	2208	
2016	0.89	0.50	1200	1068	
2017	0.86	0.0	0	0	
2018	0.84	0.0	-		

From economic studies on the value that people place on recreational fishing, 1 fishing trip is worth 15 euro.

Debit = 12 732 x €15 euro = €190,000

K Valley: Damages - Wetland Resources

- The full 10 ha of the wetland was determined to be significantly damaged by the deposited sediments as shown by sediment data, observed impacts to vegetation, and absence of any viable habitat use by migratory birds
- Bird-eating mammals would also be affected
  - Likely considered by using wetland habitat as a whole as metric

K Valley: Damage Quantification- Wetland Habitat

- For wetland habitat, the habitat equivalency approach selected, with damages quantified in terms of service reductions to valley wetland habitat.
  - Complete loss (100%) to the full 10 ha wetland assumed to occur initially, with recovery times of at least 50 years.

K Valley: Damage Quantification- Wetland Habitat

- Because of potential mobilization of contaminated sediments and future impacts to downstream resources, a remediation plan selected
  - excavation of the wetland + regrading and replanting
  - Conducted 3 years after the spill and takes 1 year to complete.
  - Recovery of wetland projected to take 10 years after that. In the end, the wetland services would be at approximately 60% of baseline levels.

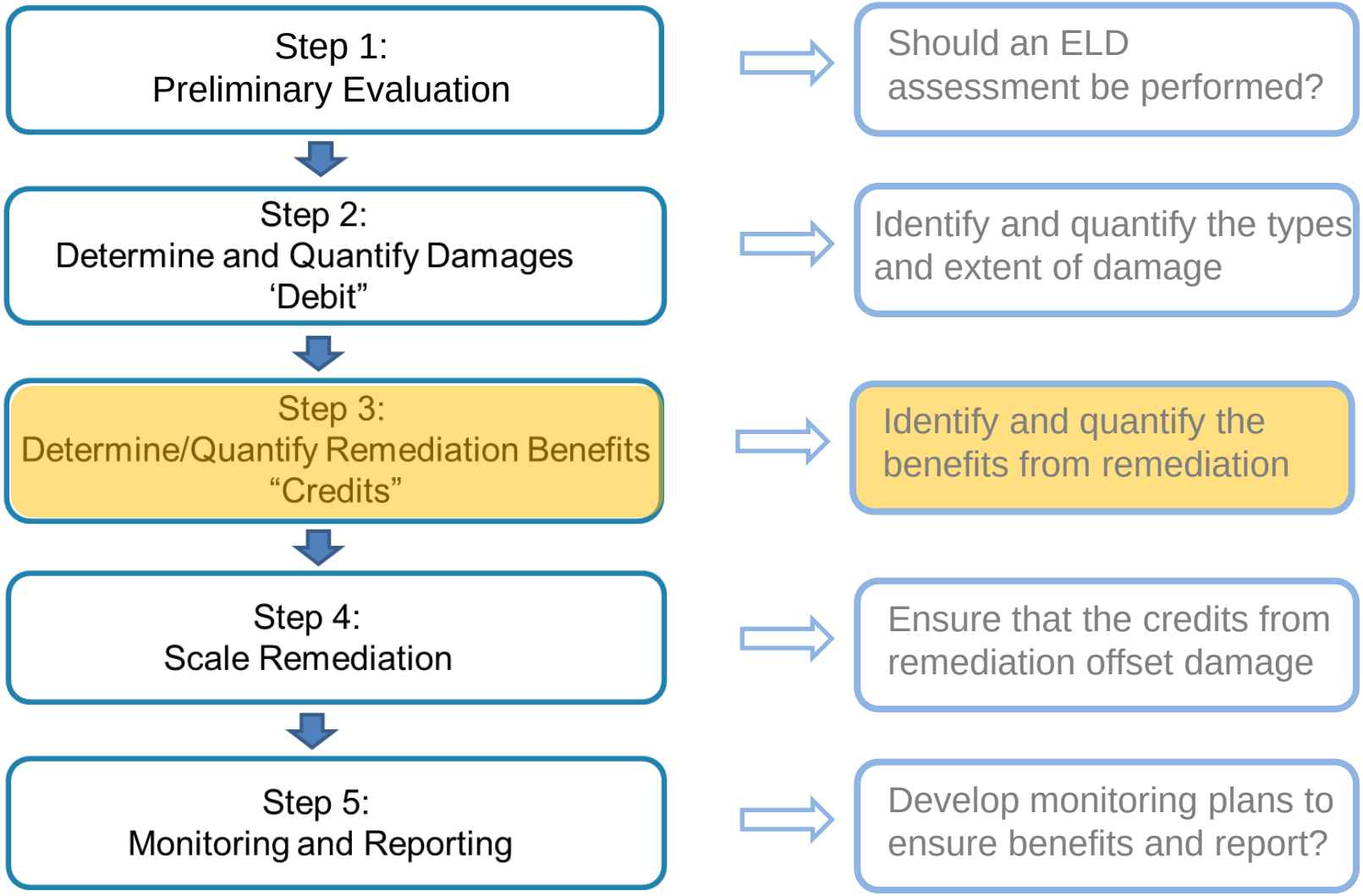
K River
Example Wetland Habitat Loss Calculation - Debit

WETLAND HABITAT

10	Area of damaged habitat (ha)
100%	Initial Resource damage (percent)
2015	Year Recovery of damaged habitat begins
10	Years until initial stage of recovery is reached
60%	Resource Loss (percent) at end of first stage
50	Additional Years to final recovery
0%	Resource Loss (percent) at end of second stage

Year	Discount Factor	Annual Wetland Habitat Injury (Percent)	Annual Wetland Habitat Injury (# ha/year)	DISCOUNTED Annual Wetland Habitat Injury (# ha/year)	TOTAL DISCOUNTED WETLAND HABITAT HA YEARS LOST
2011	1.03	1.00	10.00	10.30	174.24
2012	1.00	1.00	10.00	10.00	
2013	0.97	1.00	10.00	9.71	
2014	0.94	1.00	10.00	9.43	
2015	0.92	1.00	10.00	9.15	
2016	0.89	0.96	9.60	8.53	
2017	0.86	0.92	9.20	7.94	
2018	0.84	0.88	8.80	7.37	
2019	0.81	0.84	8.40	6.83	
2020	0.79	0.80	8.00	6.32	
2021	0.77	0.76	7.60	5.82	
2022	0.74	0.72	7.20	5.36	
2023	0.72	0.68	6.80	4.91	
2024	0.70	0.64	6.40	4.49	
2025	0.68	0.60	6.00	4.09	
….	….	….	….	….	
2072	0.17	0.04	0.36	0.06	
2073	0.16	0.02	0.24	0.04	
2074	0.16	0.01	0.12	0.02	
2075	0.16	0.00	0.00	0.00	

The ELD Assessment Process



Step 3: Determine and Quantify Benefits of Remediation

- What types of remediation projects could be conducted to replace, restore, or enhance services similar to those lost through damage?
- What credits will be generated by the remediation project(s)?
- How much time is required to implement the remediation project(s)?
- Following implementation, how long will the project(s) take to reach maximum function?

Methods of Remediation

- Examples of Habitat Remediation
  - Habitat restoration and re-creation
  - Reduction of habitat fragmentation and isolation
  - Habitat protection for loss or quality reduction
- Examples of Species Remediation
  - Protection of species from loss
  - Protection of critical habitat
  - Increase in reproductive success

Remediation Project Evaluation

(Annex II § 1.3.1)

- The effect of each option on public health and safety,
- The cost of implementing the option,
- The likelihood of success of each option,
- The extent to which each option will prevent future damage, and avoid collateral damage as a result of implementing the option,
- The extent to which each option benefits to each component of the natural resource and/or service,
- The extent to which each option takes account of relevant social, economic and cultural concerns and other relevant factors specific to the locality,
- The length of time it will take for the remediation of the environmental damage to be effective,
- The extent to which each option achieves the remediation of site of the environmental damage,
- The geographical linkage to the damaged site.

Criteria to Evaluate Remediation Projects

- ELD (Annex II, 1.3.1) identifies 9 criteria, including collateral damage of projects, consideration of “relevant social, economic and cultural concerns”, geographical linkage to the damaged site
- Criteria provide objective basis for project selection
- Public transparency
- Provide means to articulate management goals (other than just “least cost”)
- Toolkit identifies additional criteria that may be considered

Evaluation of Remediation Benefits

- Evaluation of metric equality
- Comparison of resource/service quality
- Evaluation of landscape context
- Comparison of geographic proximity
- Evaluation of social/economic context

Quantification of Remediation Benefits

- Degree of improvement to resource/service by remediation action
- Timing of improvements
- Rate of improvements
- Duration of improvements
- Accounting for uncertainty

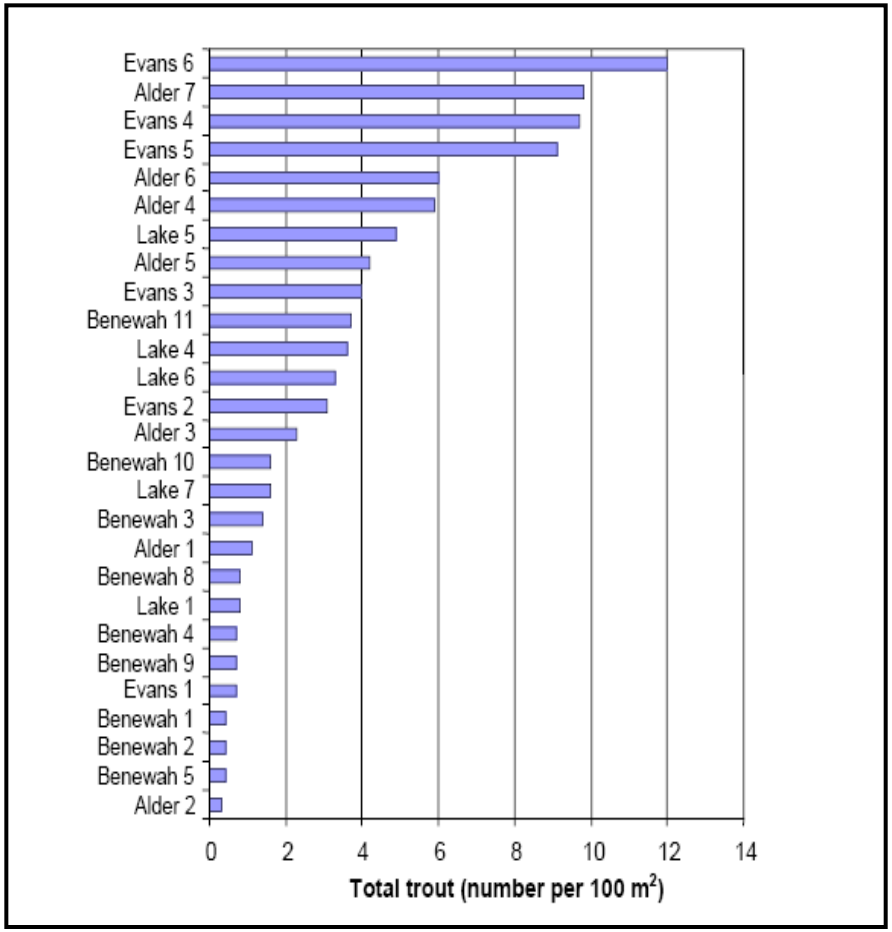
K Valley: Compensatory Remediation- Brown Trout

- To address brown trout interim losses, Three alternatives were evaluated:
  - no action (no selected b/c too much interim loss)
  - hatchery supplementation (not selected b/c of concerns regarding genetics, etc.)
  - stream restoration in other tributaries of K river

K Valley: Remediation Alternatives- Stream Restoration

K Valley: Calculating Ecological Improvement from Remediation

Local surveys regarding potential improvements in trout populations related to habitat



Compensatory Remediation Credits: Brown Trout

COMPENSATORY REMEDIATION
BENEFITS (Credits)

2014	Year Remediation begins
5	Years until remediation functioning at maximum level
5	Mean river width in Compensatory Remediation areas (m)
5	Increase in number of trout per 100 square meters in Remediation Areas
250	Increase in the number of trout per KM remediation
100	Years of Benefits

Year	Discount Factor	Annual Resource Increase per km of River Compensatory Remediation (% increase)	Annual Resource Increase per km of River Compensatory Remediation (# Fish/year)	TOTAL DISCOUNTED Annual Benefit of Compensatory Remedial Actions (# Fish / Year)
2011	1.03			
2012	1.00			
2013	0.97			
2014	0.94	0.2	50	47.1
2015	0.92	0.4	100	91.5
2016	0.89	0.6	150	133.3
2017	0.86	0.8	200	172.5
2018	0.84	1	250	209.4
2019	0.81	1	250	203.3
….	….	1	250	….
2113	0.05	1	250	12.6
2114	0.05	1	250	12.3
				7,224

Compensatory Remediation: Recreational Fishing

- Stream restoration for brown trout can provide additional fishing opportunities if access is created

- There are opportunities to improve fishing along other nearby rivers

K Valley: Compensatory Remediation- Wetlands

- To address interim wetland losses, three alternatives evaluated: no action, off-site wetland restoration, and protection through acquisition.
  - No action not selected b/c too much interim loss.
  - Wetland restoration not selected because services lost in perpetuity were related to natural, diverse wetlands.
  - Selected alternative is protection/acquisition scenario.

Compensatory Remediation Credits: Wetland Habitat

COMPENSATORY REMEDIATION BENEFITS (Credits)

2015 Year Protection begins

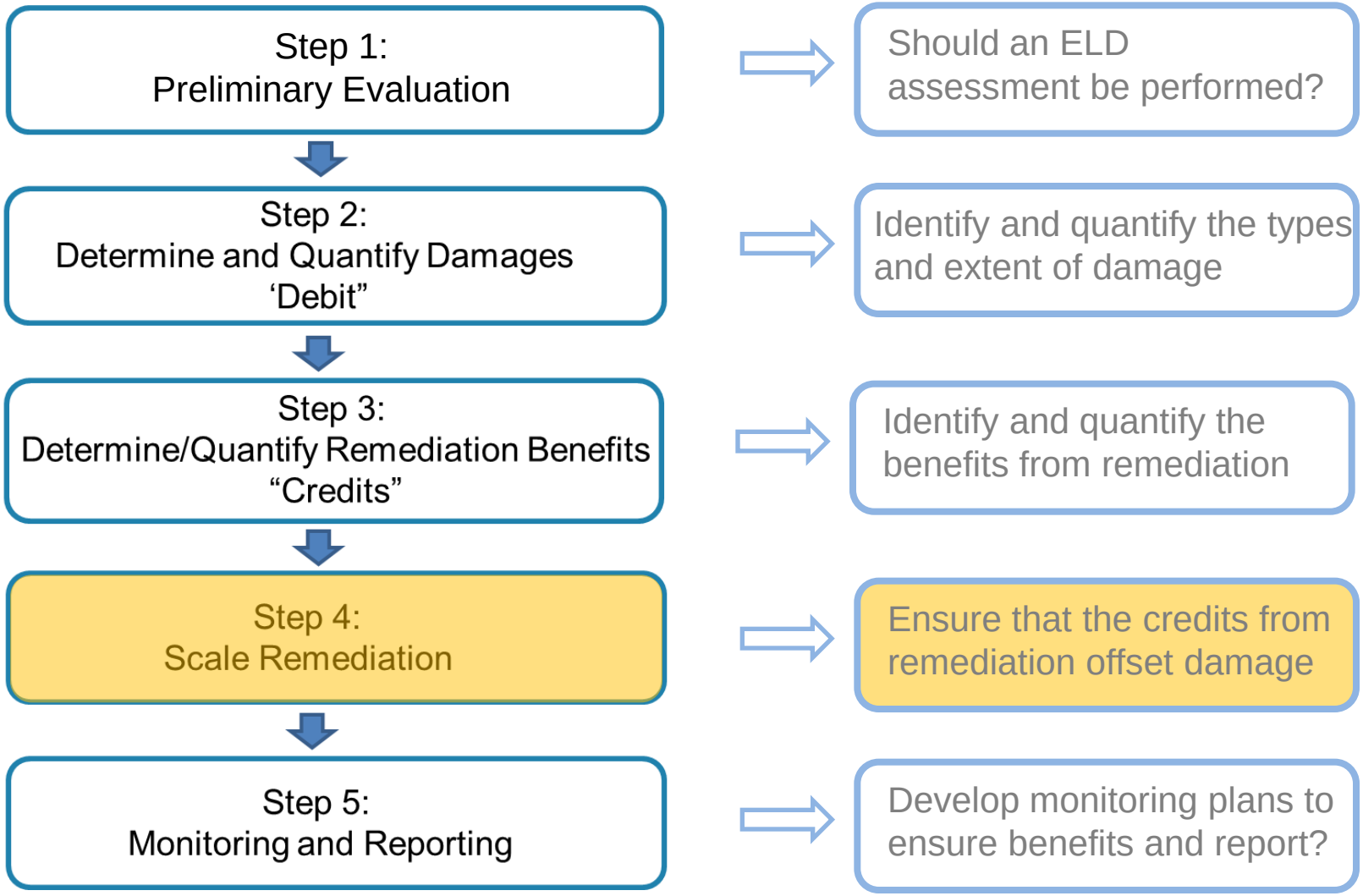
10 Years when a probable loss of habitat is likely

Equal probability of loss in any of the 10 years

100 Years benefits provided

Year	Discount Factor	Annual Wetland Habitat Credit - Protection for future loss (Probability of loss in year)	Annual Resource Increase per ha of Wetland Compensatory Remediation (# ha/year/ha)	TOTAL DISCOUNTED Expected Annual Benefit of Compensatory Remedial Actions (# ha credit / Year/ ha)	TOTAL DISCOUNTED Expected Benefit of Compensatory Remedial Actions (# ha)
2011	1.03				26.2
2012	1.00				
2013	0.97				
2014	0.94				
2015	0.92	0.1	32.6	3.0	
2016	0.89	0.1	32.6	2.9	
2017	0.86	0.1	32.6	2.8	
2018	0.84	0.1	32.6	2.7	
2019	0.81	0.1	32.6	2.7	
2020	0.79	0.1	32.6	2.6	
2021	0.77	0.1	32.6	2.5	
2022	0.74	0.1	32.6	2.4	
2023	0.72	0.1	32.6	2.4	
2024	0.70	0.1	32.6	2.3	
2025	0.68				

The ELD Assessment Process



Step 4:
Scale Remediation to Compensate for the Damage

- Compute total discounted debit to reflect interim loss (in the past, present, and future) from the time of the incident
- Compute a total discounted credit to reflect benefits of the remediation
- Scale the remediation so that total discounted service losses of debit are equal to the discounted service gains of credit

Scale Remediation to Compensate for the Damage

- Scaling includes the estimated of cost for remediation options
  - Per unit cost of remediation?
- Includes and evaluation of whether costs are disproportionate to benefits

Scaling Compensatory Remediation River/Trout Damages

7,224	Total Discounted increase in fish per KM of Compensatory Remediation (CREDIT)
81,703	Total Discounted DEBIT
11.31	Total Number of KM of Compensatory Remediation necessary

Scaling Compensatory Remediation: Recreational Fishing

- For Value to cost approach, the “scale” of the compensatory remediation is determined by the value of damage calculation
- The value of the damage (€190 000) is collected and used to undertake remediation actions.
- The scale of compensatory remediation is how many projects can be done for € 190 000.

Scaling Compensatory Remediation Wetland Habitat

26.2	Total Discounted increase in Wetland habitat benefits per ha of Compensatory Remediation (CREDIT)
174	Total Discounted DEBIT
6.65	Total Number of ha of Wetland Habitat protection necessary

Categories of Remediation Project Costs

- Project design
- Project implementation
- Project administration
- Operation and maintenance
- Adaptive management/contingencies
- Monitoring and reporting
- Competent Authority oversight

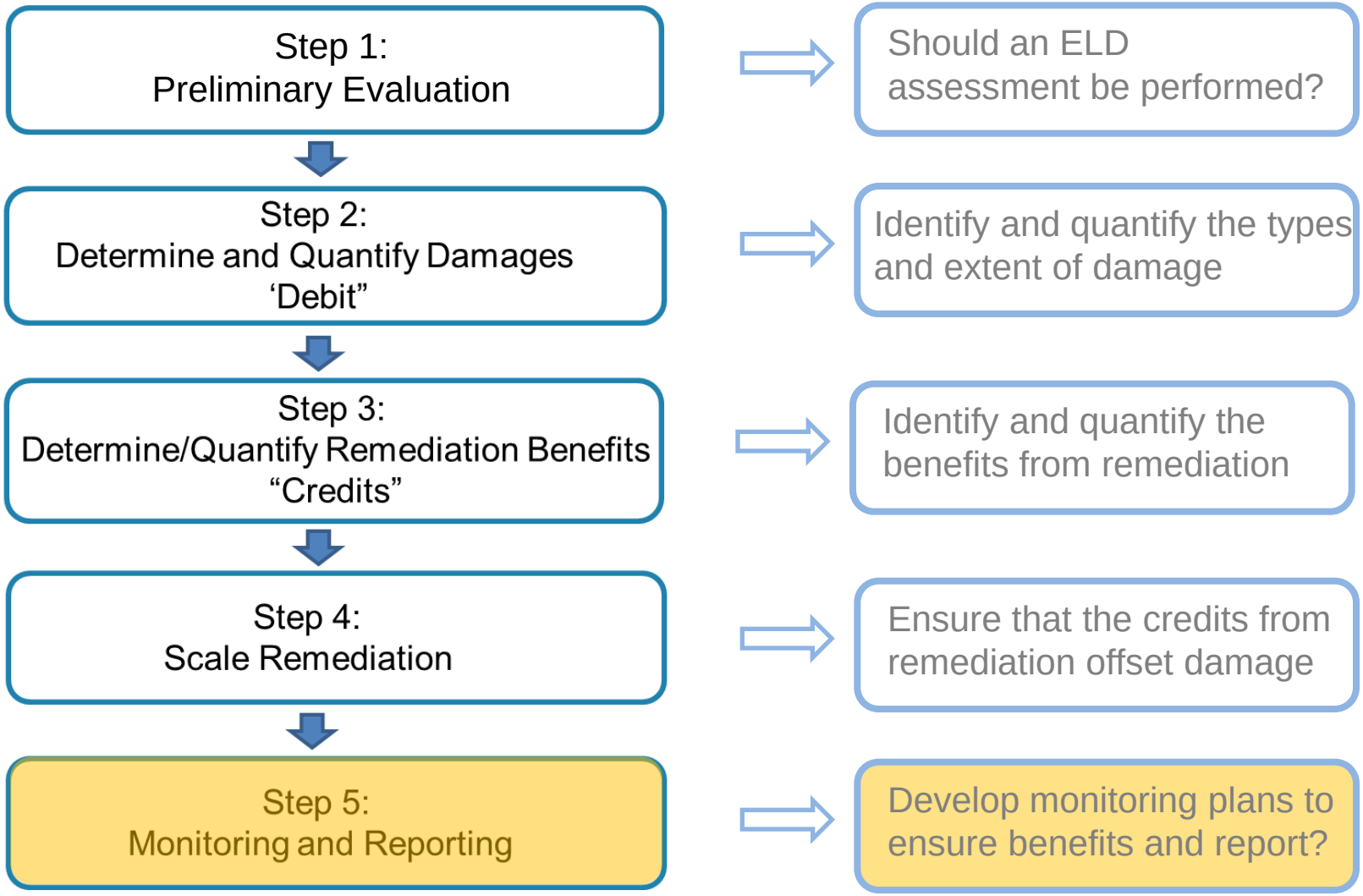
Remediation Cost Components

Summary of important cost components when estimating remediation cost	
Cost	**Description**
Planning	Planning and design, including preliminary surveys.
Acquisition of permits, land	Acquisition of any necessary permits or access requirements. Land (or other assets) may need to be acquired.
Implementation	Labour, materials, transport, infrastructure development, site management and oversight, supplies.
Operation and Maintenance	All costs required to run and manage the project, including labour, equipment, materials, and supplies.
Oversight	Oversight by Competent Authorities, including labour time and administrative overhead costs.
Monitoring and Reporting	Including costs of labour, materials, supplies, and information dissemination.
Failure contingency	All necessary and appropriate contingency costs that apply to uncertainties associated with project execution. General practice is between 20-40% of total estimated costs.

Cost of Compensatory Remediation

	Trout Remediation	Wetland Remediation	Recreational Fishing
Planning	75,000 €	50,000 €	
Permitting	25,000 €	25,000 €	
Construction (€ / unit for Improvement of existing areas)	75, 000 € / km @ 11.31 km 848,250 €	25,000 € / ha @ 6.65 ha 166,250 €	190 000 €
Maintenance (Total for 10 years)	50,000 €	25,000 €	
Monitoring Reporting	5,000 €	5,000 €	
SUM	1,003,250 €	271,250 €	1,464,500 €

The ELD Assessment Process



Step 5:
Monitoring and Reporting

- Tracking to make sure that anticipated benefits from remediation occur
- Ability to adjust remediation if necessary
- Documenting and reporting results

Types of Monitoring

- Baseline monitoring for future comparisons
- Status monitoring
- Trend monitoring
- Implementation monitoring
- Effectiveness monitoring
- Validation monitoring

Reporting

- Reporting not an ELD requirement of the ELD. However, Authorities may wish to consider making damage assessment reports available for public review at regular intervals and in an accessible format.

Reporting: Purposes

- Communicating remediation plan successes (and failures) to the affected publics
- Communicating necessary alterations in monitoring design or anticipated recovery rates to the affected public
- Communicating any potential human health risks (or lack thereof) to the affected public
- Contributing to scientific knowledge regarding remediation efficacy and recovery rates

K Valley: Monitoring and Reporting

- Brown trout sampling
- Water quality sampling
- Sediment sampling
- Development of performance criteria and recovery monitoring for primary remediation wetland
- Annual data report + evaluative report on conditions on site and at remediation sites at years 5 and 10

“Supplemental” Liability from ELD?

- Cost of assessment: 500,000 Eur
- Cost of remediation: 1.3M Eur
- Cost of monitoring/reporting: 250,000 Eur
- “Supplemental” liability: ~2M Eur

Small Group Exercise

- Hands on exercise to undertake a simplified assessment
- Break into groups of no more than three
- Read materials and discuss options, approaches and outcomes
- Write down results for full group discussion
- Expected to take approximately 3.5 hrs

For more information

http://ec.europa.eu/environment/legal/liability/index.htm