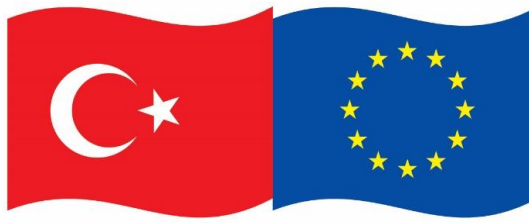




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# Case Studies on Ecological Risk Assessment

Robert Rachman

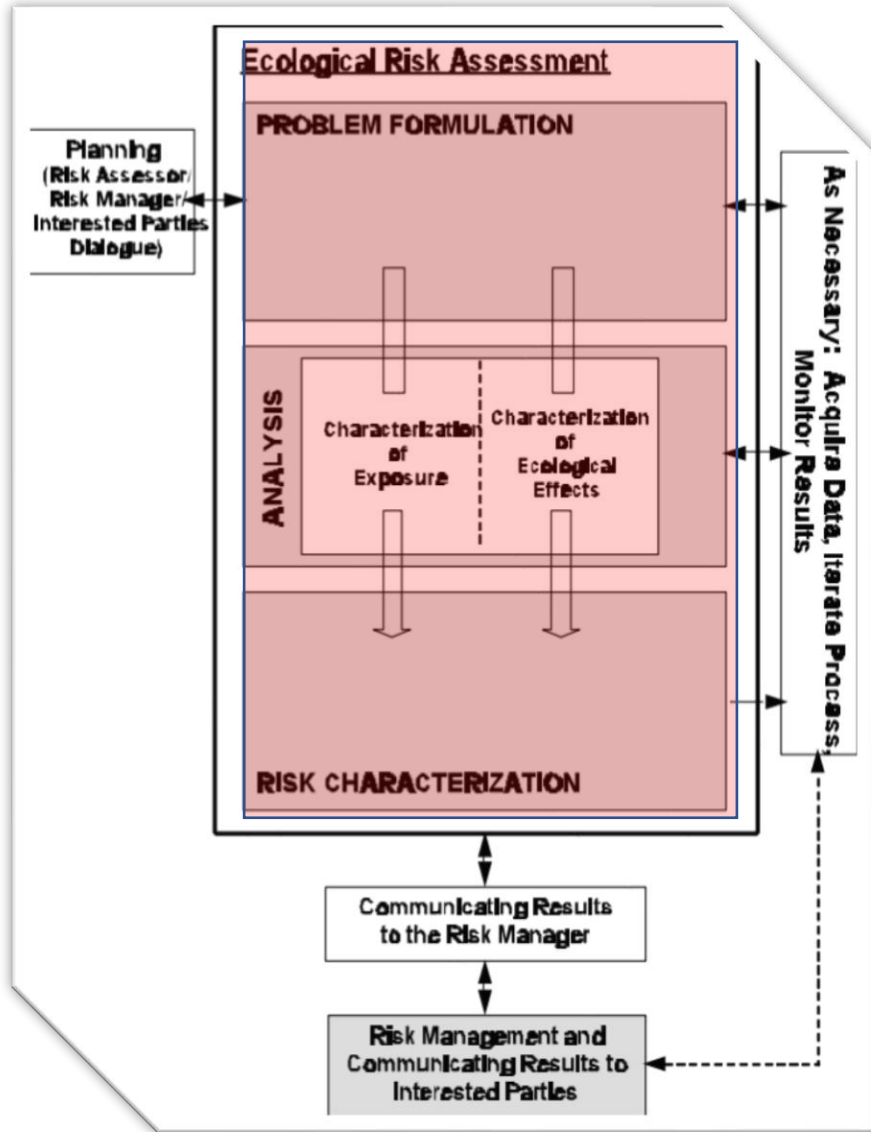


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## Phases of ERA Process

1. Planning
  2. Problem Formulation
  3. Analysis
  4. Risk characterization
  5. Risk Management
- } ERA

Case Study for the Texas Commission On Environmental Quality  
(Case Study for the TCEQ's Ecological Risk Assessment Process,  
August 2018)





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# Prospective – Retrospective ERA



Retrospective

Prospective



Case Study



REPUBLIC OF TURKEY  
MINISTRY OF ENVIRONMENT  
AND URBANISATION



Environment and Climate Action  
Sector Operational Programme



Persistent  
Organic  
Pollutants



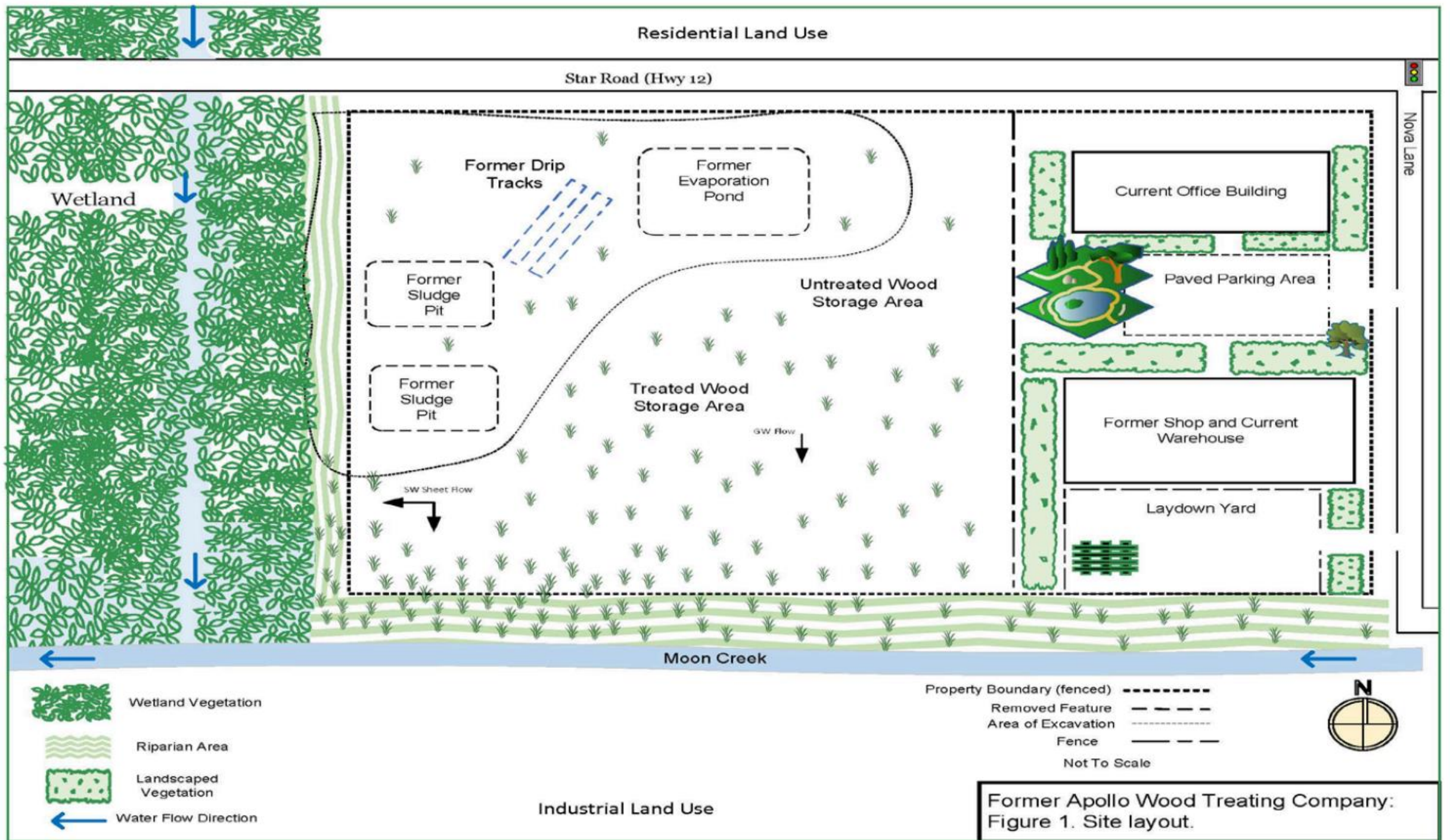


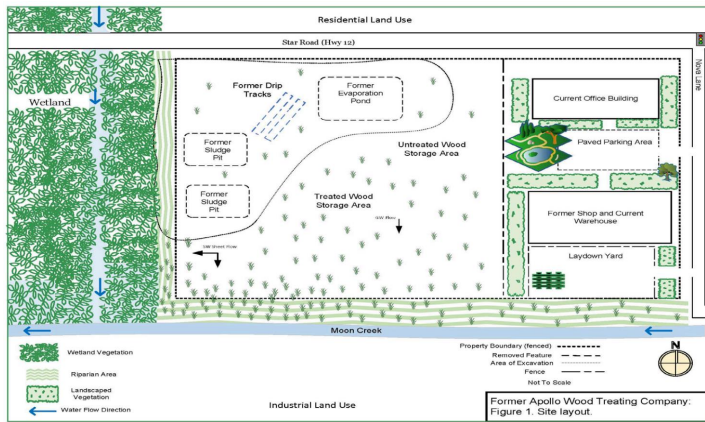


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## Site History

- From 1950 until 2004, the Apollo Wood Treating Company (AWTC) produced poles, foundation pilings, and lumber in a plant on a 60 750 m<sup>2</sup> site near Orion, Texas in Sunny County
- Wood was treated under pressure in a heated oil-based solution containing creosote, pentachlorophenol (PCP) and chromated copper arsenate (CCA).
- After treatment, the wood was removed and allowed to dry outside on drip tracks, resulting in large volumes of contaminated soil. On-site soil received drippings from treated wood and spills of wood-treating chemicals.
- Process wastewater (after separation of recoverable chemicals), was spread on-site or stored in an evaporation pond.
- Sludge gradually accumulated in the wastewater evaporation pond was dumped into unlined pits on-site.



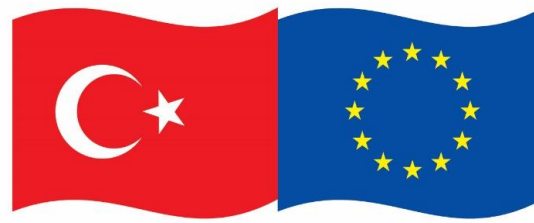
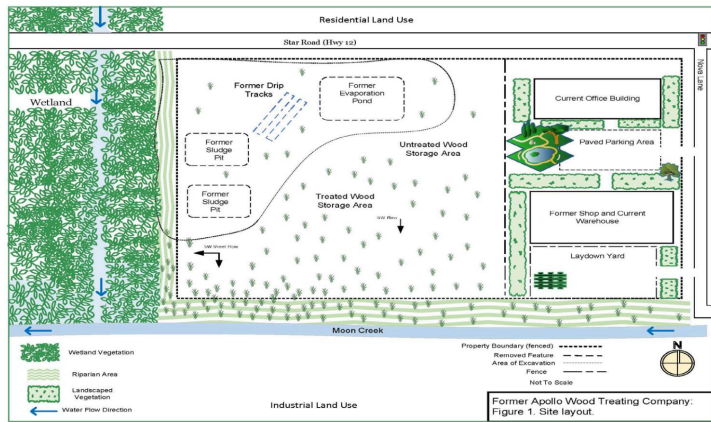


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## Site Surroundings

- The site is adjacent to a large, permanently inundated wetland that receives surface runoff from north, water in the wetland flows south and enters Moon Creek.
- Moon Creek located south of the site is not a classified stream segment, but two miles downstream, it empties into Lake Jupiter, which is classified (not shown on the site layout).
- Based on depth of the shallow groundwater level - 2.5 m below ground surface (bgs) - and the depth of Moon Creek, impacted groundwater is believed to discharge to Moon Creek south of the site.
- Although surface water runoff from the site is primarily to the south, the proximity of the wetland (and its riparian area) to the former sludge pits made it susceptible to runoff from the site during significant rain events.
- East of the site are commercial facilities (office building, parking area, warehouse, laydown yard)

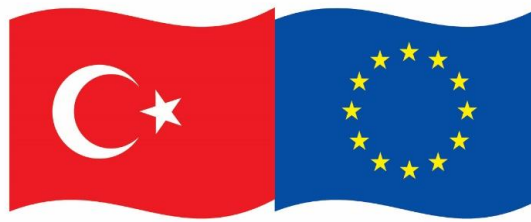
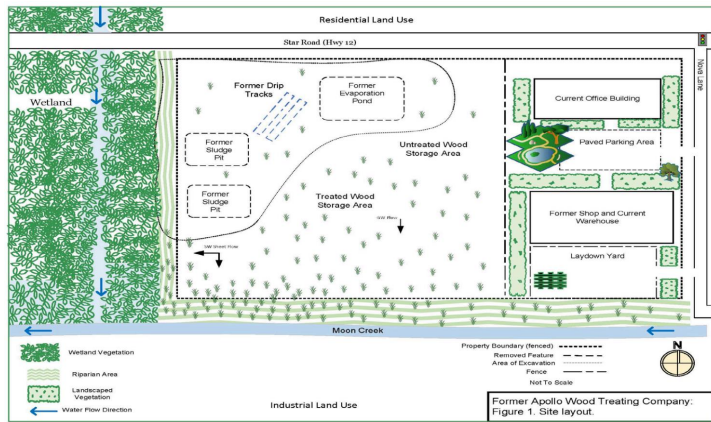




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## Site Remediation in 2006

- All above-ground structures associated with wood treatment were demolished and removed.
- Any wastes remaining in the evaporation pond and sludge pits were removed and disposed of off-site.
- Soil was excavated from the former wood treating area and also the riparian zone west of the area (as it received overflows from the former sludge pits).
- Figure shows the outline of the 2006 excavation area and the former wood treating area.
- Today, the on-site area is not maintained, and the excavated riparian area has recovered to its former status and function. The on-site area is overgrown with grass, weeds, and shrubs. Birds, mammals, and reptiles have been observed on the affected property. They have also been observed on the off-site creek and wetland (and their riparian areas).



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## Site Investigation in 2008

- Chemicals of concern (COCs) found on the site include metals, PCP, polycyclic aromatic hydrocarbons (PAHs), and dioxins/furans.
- In the unexcavated central part of the former facility, on-site surface and subsurface soils were contaminated, primarily where the treated wood was stored.
- The shallow groundwater (2.5 -3 m bgs) may be in contact with affected subsurface soils. COCs from the affected soils could move into the groundwater and then discharge into Moon Creek.
- Deeper groundwater has not been affected by historical operations at the site.
- Groundwater samples collected from a temporary well near the commercial facilities (east) did not indicate any contamination.
- Surface water and sediment samples collected from the creek and wetland indicated the presence of facility-related chemicals.




1. **PLANNING**
2. **PROBLEM FORMULATION**
3. **ANALYSIS**
4. **RISK CHARACTERIZATION**
5. **RISK MANAGEMENT**



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## ERA Planning

- What is the nature of the problem?
  - What are the ecological values of concern?
  - What are the policy considerations (law, social, environmental, corporate policy etc.)
  - What are the management goals and decisions needed?
  - What is our state of knowledge of the problem?
- 
- What resources are available (personal, financial, ...)?
  - What are the ecosystem characteristics and ecological endpoints?
  - How likely is recovery of the ecosystem and how long will it take?
  - How will risk assessment help?
  - etc.

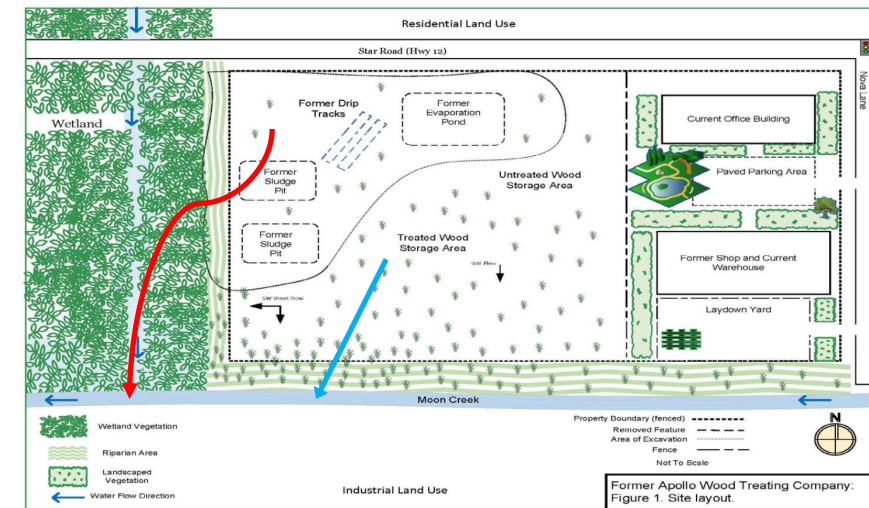
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2. **PROBLEM FORMULATION**
3. **ANALYSIS**
4. **RISK CHARACTERIZATION**
5. **RISK MANAGEMENT**



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## Ecological Setting and Screening Level Assessment

- Investigation data (2008) show that soil, sediment, groundwater and surface water contain or are suspected of containing organic or inorganic constituents.
- Moon Creek discharges to Lake Jupiter (3.2 km downstream, classified „high aquatic life use“).
- A large freshwater wetland is located west of the former facility and it flows into Moon Creek.
- Multiple completed ecological exposure pathways are identified for this affected site: (i) **Contaminated soil**  $\Rightarrow$  **Shallow groundwater**  $\Rightarrow$  **Moon Creek**, (ii) **Impacted surface water runoff**  $\Rightarrow$  **Wetland**  $\Rightarrow$  **Moon Creek**.



1. **PLANNING**
2. **PROBLEM FORMULATION**
3. **ANALYSIS**
4. **RISK CHARACTERIZATION**
5. **RISK MANAGEMENT**



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- None of the exposure pathways are planned to be removed by an immediate response action.
- As birds, mammals, and reptiles have been observed on-site, the site could serve as habitat, foraging area, or refuge to protected species.
- Birds, mammals, and reptiles have been observed on the affected property.
- Burrows of depth potentially reaching the contaminated subsurface were noted on-site.
- Additional evaluation is needed for the decision if the existing pollution by COCs must be reduced so that it does not pose an ecological risk, and (if so) to develop protective concentration levels (PCL for those COCs that do pose an unacceptable risk to selected ecological receptors).



1. PLANNING
2. **PROBLEM FORMULATION**
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- *Information summary*
- *Assessment endpoints*
- *Conceptual model*
- *Analysis plan*

## Problem Formulation

- **Environmental setting:** Site area and location, Site history (historical activities / operations, used COCs, present/future use), Surroundings (ecologically sensitive areas, potential pollution sources etc.), Potentially affected surface water bodies, Geology / hydrogeology, Contamination data, Earlier implemented and planned remediation measures etc.
- **Ecological resources:** Limited to urban terrestrial wildlife (e.g. American robin) and freshwater aquatic life in the stream. The wetland to the west of the site provides sufficient cover and forage for a variety of species, both terrestrial and aquatic. The former wood-treating and wood-storage areas are covered with grass, weeds, shrubs, and a few small trees.
- **Benchmark screening of contamination data**
- **Assessment endpoints and Selection of biological systems for evaluation**
- **Conceptual model and Analysis plan**

1. PLANNING
2. **PROBLEM FORMULATION**
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- **Assessment endpoints**
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- **Analysis plan**

## Benchmark Screening

- Contamination data: Sampling and chemical analysis
- Data evaluation: Benchmark screening ( <https://www.tceq.texas.gov/remediation/eco> ) ⇒ **COC**

Wetland sediment  
data summary and  
benchmark  
screening.

COC	General Area	Max Detect (mg/kg)	Data Flags	Detections	Sediment Freshwater Benchmark (mg/kg)	Benchmark Exceedance Count	Retain COC?
Arsenic	Upstream of Wetland	7.54		10/10	9.79	0	NA - upstream of wetland
Cadmium	Upstream of Wetland	0.63		4/10	0.99	0	NA - upstream of wetland
Chromium	Upstream of Wetland	40.8		10/10	43.4	0	NA - upstream of wetland
Copper	Upstream of Wetland	30.3		10/10	31.6	0	NA - upstream of wetland
Lead	Upstream of Wetland	30.8		10/10	35.8	0	NA - upstream of wetland
Zinc	Upstream of Wetland	109		10/10	121	0	NA - upstream of wetland
PCP	Upstream of Wetland	0.0039	U	0/10	1.2	0	NA - upstream of wetland
TPAHs	Upstream of Wetland	3.22		10/10	1.61	7	NA - upstream of wetland
TCDD TEQ (Avian)	Upstream of Wetland	9.0E-07		2/2	NA	NA	NA - upstream of wetland

...





1. PLANNING
2. **PROBLEM FORMULATION**
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- *Information summary*
- ***Assessment endpoints***
- *Conceptual model*
- *Analysis plan*

## Assessment Endpoints

**Assessment endpoints** = „explicit expressions of the actual environmental value to be protected“ (US EPA):

- Protection of wildlife, including protected species, with no unacceptable risk to species diversity and abundance (and viable reproduction) due to COCs in soils, sediment, and surface water
- Protection of the benthic invertebrate community, including protected species in Moon Creek and the wetland, with no unacceptable risk to species diversity due to site-related COCs.
- Protection of the aquatic life community in Moon Creek and the wetland, with no unacceptable risk to species diversity due to site-related COCs.

1. PLANNING
2. **PROBLEM FORMULATION**
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- *Information summary*
- **Assessment endpoints**
- *Conceptual model*
- *Analysis plan*

## Evaluated Biological Systems

### (i) **Freshwater systems habitat** (Moon Creek and the wetland area):

- Herbivorous birds and mammals (e.g., red-winged blackbird and swamp rabbit)
- Omnivorous birds and mammals (e.g., American wigeon and raccoon aquatic)
- Carnivorous birds, mammals, and reptiles (e.g., kestrel, mink, and plain-bellied water snake)
- For Moon Creek, all but eight of the aquatic species listed in the Freshwater Systems Habitat were evaluated (e.g. American alligator and bald eagle were not included as they require large fish as prey which are not present in Moon Creek).
- For the wetland, all the species eliminated in the Moon Creek assessment were eliminated from the wetland for the same reasons. In addition, because the wetland did not provide water at a sufficient depth for foraging, the belted kingfisher was removed as a receptor.

### (ii) Minor habitat-terrestrial – similar evaluation performed

Assoc. Species	Habitat Name	Habitat ID	Description		
▶	DESERT-ARID	DESERT-ARID	Vegetative cover is predominantly semi-desert grassland and arid shrubland, except for high elevation islands of oak, juniper, and pinyon pine woodland. Example: Trans Pecos area.		
▶	ESTUARINE SYSTEMS	ESTUARINE SYSTEMS	Saline and brackish wetlands are complex and highly productive ecosystems, containing a variety of plant and animal species that are specially adapted to fluctuations in salinity, water levels, and seasonal temperatures and can include saltwater marshes, sand flats, sandy sea shores, mangrove swamps, and barrier islands. Example: Gulf Coast region.		
▼	FRESHWATER SYSTEMS	FRESHWATER SYSTEMS	Encompasses a wide variety of aquatic habitats including rivers, creeks, swamps, marshes, bogs, and flood plains. Many protected species utilize wetland habitat, and most species of amphibians are dependent on sources of water (such as wetlands) for reproductive success. Example: Riparian areas throughout the State.		
AMERICAN ALLIGATOR (AQ)	AMERICAN KESTREL (TR)	AMERICAN MINK (AQ)	AMERICAN ROBIN (TR)	AMERICAN WIGEON (AQ)	AMERICAN WOODCOCK (TR)
BALD EAGLE (AQ)	BELTED KINGFISHER (AQ)	BLACK CROWNED NIGHT HERON (AQ)	BOBCAT (TR)	CANADA GOOSE (AQ)	COMMON YELLOW THROAT (TR)
COTTON MOUSE (TR)	COTTONMOUTH WATER MOCASSIN (AQ)	COYOTE (TR)	EASTERN COTTONTAIL (TR)	EASTERN LEAST TERN (AQ)	GREAT BLUE HERON (AQ)
GREEN HERON (AQ)	INTERIOR LEAST TERN (AQ)	LEAST SHREW (TR)	MALLARD (AQ)	MARSH RICE RAT (AQ)	MARSH WREN (AQ)
MUSKRAT (AQ)	NORTHERN HARRIER (TR)	OSPREY (AQ)	PLAIN-BELLIED WATER SNAKE (AQ)	RACCOON SEMI-AQUATIC (AQ)	RED FOX (TR)
RED WINGED BLACKBIRD (AQ)	SNAPPING TURTLE (AQ)	SNOW GOOSE (AQ)	SNOWY EGRET (AQ)	SOUTHERN SHORT-TAILED SHREW (TR)	SPINY SOFT SHELL TURTLE (AQ)
SPOTTED SANDPIPER (AQ)	SWAMP RABBIT (AQ)	TIMBER RATTLESNAKE (TR)	VIRGINIA OPOSSUM (TR)	WHITE FACED IBIS (AQ)	WHOOPIING CRANE (AQ)
YELLOW CROWNED NIGHT HERON (AQ)	YELLOW MUD TURTLE (AQ)				
▶	MINOR	MINOR	Fragmented ecological habitat or isolated island-like areas that cannot easily be categorized among the seven major habitats (e.g., an unmaintained grassy area adjacent to a laydown yard or a small, man-made stock pond). Included species are representative of a variety of feeding guilds and are useful for generalized PCL analysis.		
▶	MINOR HABITAT - AQUATIC	MINOR AQUATIC	A subset of the MINOR habitat containing only aquatic organisms.		
▶	MINOR HABITAT - TERRESTRIAL	MINOR TERRESTRIAL	A subset of the MINOR habitat containing only terrestrial organisms.		
			Native shortgrass prairie features blue grama, buffalograss, and fringed sage, and mixed grass areas; also includes sand sage prairie and Shipnery sands areas. One of the most		



1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- Information summary
- Assessment endpoints
- Conceptual model
- Analysis plan

## Protected Species

The federal and state-listed species for Sunny County are presented in the table below. The table presents the habitat requirements of the protected species and includes a determination of the potential presence of that species at the site. This evaluation concludes that the timber rattlesnake and white-faced ibis could be present at or around the site and therefore were included as potential receptors.

Species <sup>4</sup>	Species Category	Listing Status <sup>5</sup>	Associated Habitat	Potentially on Affected Property?
American Peregrine falcon ( <i>Falco peregrinus anatum</i> )	Bird	ST	Nests in tall cliff eyries; winters along coast and farther south; occupies wide range of habitats during migration including urban and lake shores.	No - site habitat does not correspond to species requirements
Bald Eagle ( <i>Haliaeetus leucocephalus</i> )	Bird	ST	In Texas, preferred nesting habitat is along river systems, or within 1-2 miles of some other large water body. Fish is the primary food, but also prey on waterfowl, turtles, small mammals, and carrion (TPWD, 2018a).	No - Moon Creek does not represent a body of water of suitable size.
Interior Least Tern ( <i>Sterna antillarum athalassos</i> )	Bird	FE, SE	Prefers open habitat and avoids thick vegetation and narrow beaches. Sand and gravel bars within a wide unobstructed river channel or open flats along lake shore.	No - habitat does not correspond to species requirements
White-faced ibis			Preferred nesting habitat includes marshes, sloughs, and in fields, particularly those with crackish and saltwater influence.	Yes - freshwater wetland and

1. PLANNING
2. **PROBLEM FORMULATION**
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT

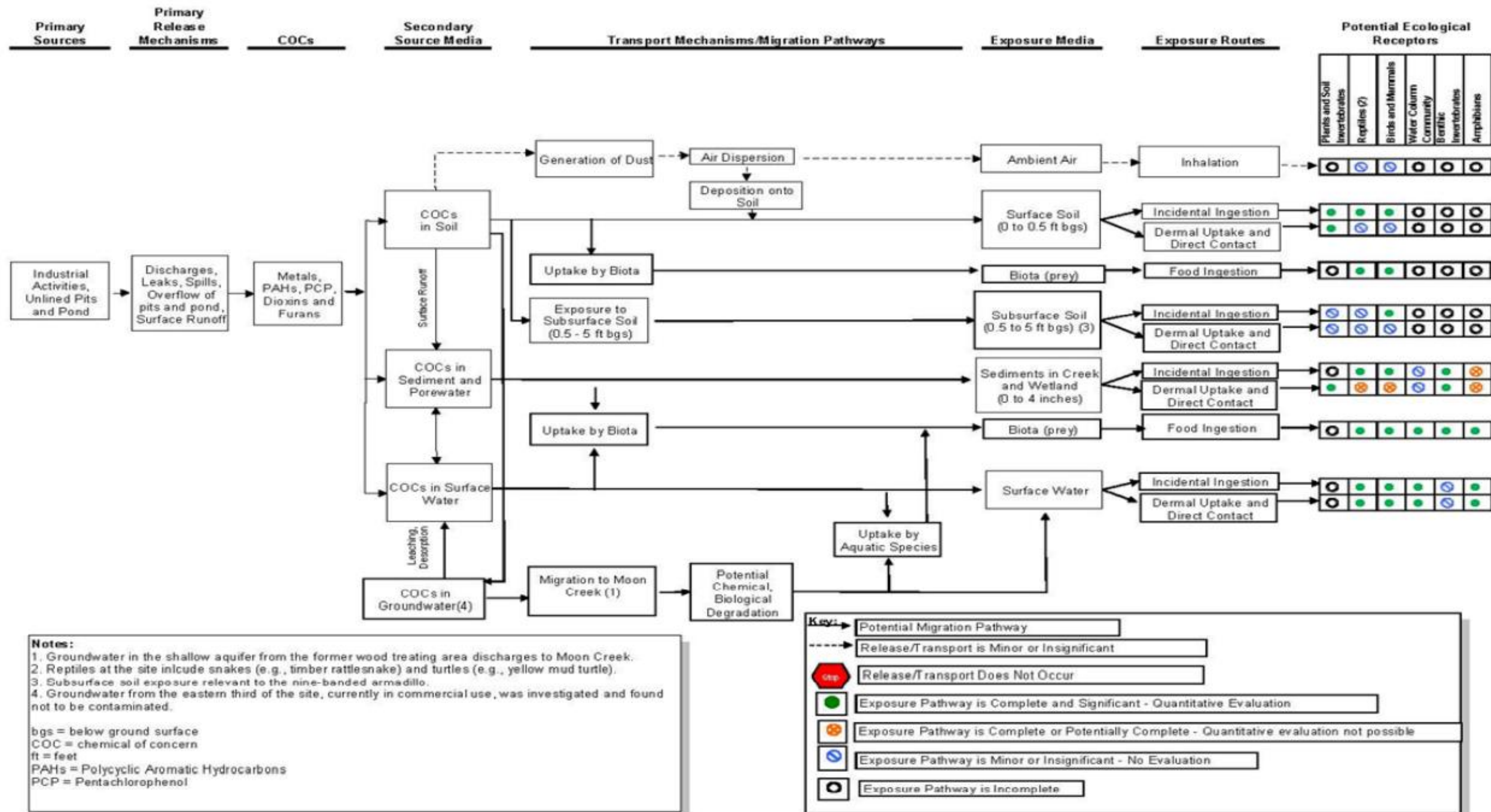


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- *Information summary*
- *Assessment endpoints*
- ***Conceptual model***
- *Analysis plan*

## Conceptual Model

- Potential contaminant sources: (i) Primary (industrial wood treating activities and the unlined pits and ponds); (ii) Secondary (soil, sediment, surface water, and groundwater)
- Release mechanisms: Discharges, leaks, spills, overflow of the pits and pond, and surface runoff
- Transport pathways: (i) Physical (discharge from groundwater to surface water); (ii) Biological: uptake into biota consumed by other ecological receptors
- Exposure media: Ambient air, surface soil, subsurface soil, sediments in the creek and wetland, and surface water
- Exposure routes: Inhalation, ingestion, dermal contact, and ingestion of food
- Potential receptors: Terrestrial plant and soil invertebrate communities, reptiles, birds, mammals, water column community, benthic community, and amphibians





1. PLANNING
2. **PROBLEM FORMULATION**
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- *Information summary*
- *Assessment endpoints*
- *Conceptual model*
- ***Analysis plan***

## Analysis Plan

The analysis plan is the final synthesis before the risk assessment proceeds - it:

- Summarizes what has been done during problem formulation
- Shows how the plan relates to management decisions that must be made
- Indicates (i) how data and analyses will be used to estimate risks and (ii) additional data needed for the analysis

When the problem is clearly defined and there are enough data to proceed, analysis begins.

1. PLANNING
2. PROBLEM FORMULATION
3. **ANALYSIS**
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



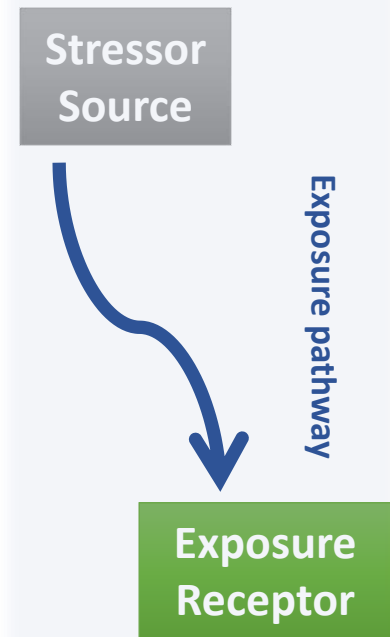
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- **Analysis of exposure**
- **Analysis of effects**

## Analysis of Exposure

- a) Characterization of stressors: COCs content in media (investigation data)
- b) Source identification:
  - Primary: Industrial wood treating activities and the unlined pits and ponds
  - Secondary: Soil, sediment, surface water, and groundwater
- c) Determination of exposure receptors: Birds, mammals reptiles, amphibians (biological survey)
- d) Identification of habitats associated with exposure receptors: Freshwater and Minor Terrestrial systems
- e) Representative receptors
- f) Exposure pathway analysis
- g) Exposure profile (summary of the analysis)

### EXPOSURE:



1. PLANNING
2. PROBLEM FORMULATION
3. **ANALYSIS**
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- *Analysis of exposure*
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## Representative Receptors

- Affected site contains several habitats and a variety of associated species  $\Rightarrow$  Huge scope of exposure analysis, missing exposure characterization data etc.
- Selection of several representative receptors for which exposure is analyzed
- Representative receptors must be selected for (i) all relevant habitats and (ii) for each feeding guild of individual habitats
  - » Feeding guild: Broad group of related ecological receptors (e.g. birds) that represent the variety of species potentially exposed to COCs at the affected property. Feeding guilds are based on a shared feeding strategy, similar potential for exposure, and physiological or taxonomic similarity.
- The species for which data exposure characterization data are available must be selected as representative receptors.

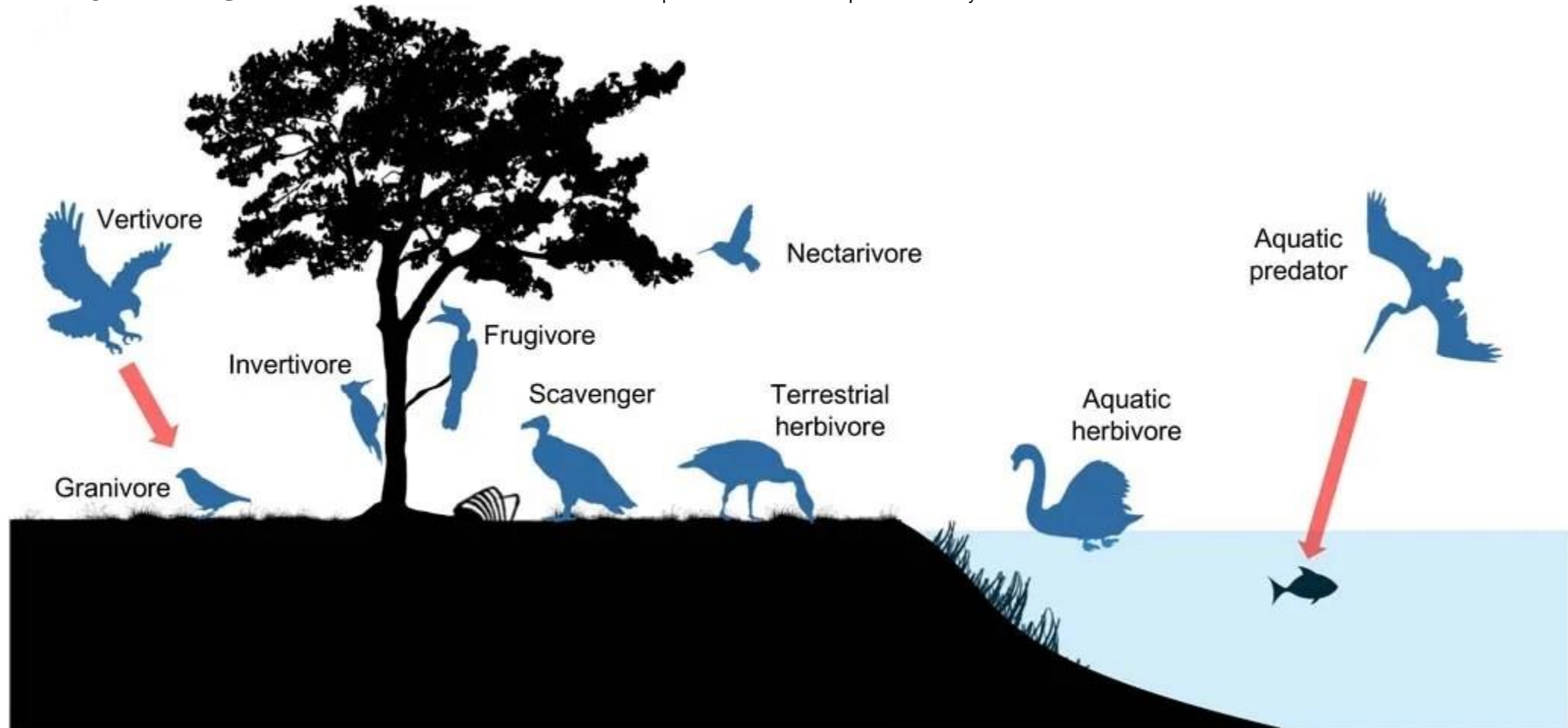


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2. PROBLEM FORMULATION
3. **ANALYSIS**
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- **Analysis of exposure**
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1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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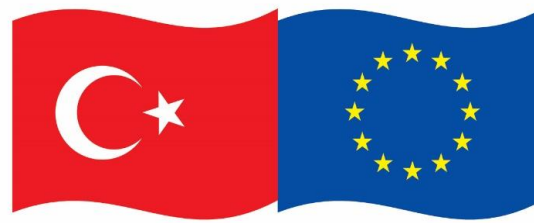
- Analysis of exposure
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## Representative Receptors - Database

Minor terrestrial habitat species for which exposure characterization parameters are published in the TCEQ database

Assoc. Species	Habitat Name	Habitat ID	Description		
▶	<a href="#">DESERT-ARID</a>	DESERT-ARID	Vegetative cover is predominantly semi-desert grassland and arid shrubland, except for high elevation islands of oak, juniper, and pinyon pine woodland. Example: Trans Pecos area.		
▶	<a href="#">ESTUARINE SYSTEMS</a>	ESTUARINE SYSTEMS	Saline and brackish wetlands are complex and highly productive ecosystems, containing a variety of plant and animal species that are specially adapted to fluctuations in salinity, water levels, and seasonal temperatures and can include saltwater marshes, sand flats, sandy sea shores, mangrove swamps, and barrier islands. Example: Gulf Coast region.		
▶	<a href="#">FRESHWATER SYSTEMS</a>	FRESHWATER SYSTEMS	Encompasses a wide variety of aquatic habitats including rivers, creeks, swamps, marshes, bogs, and flood plains. Many protected species utilize wetland habitat, and most species of amphibians are dependent on sources of water (such as wetlands) for reproductive success. Example: Riparian areas throughout the State.		
▶	<a href="#">MINOR</a>	MINOR	Fragmented ecological habitat or isolated island-like areas that cannot easily be categorized among the seven major habitats (e.g., an unmaintained grassy area adjacent to a laydown yard or a small, man-made stock pond). Included species are representative of a variety of feeding guilds and are useful for generalized PCL analysis.		
▶	<a href="#">MINOR HABITAT - AQUATIC</a>	MINOR AQUATIC	A subset of the MINOR habitat containing only aquatic organisms.		
▼	<a href="#">MINOR HABITAT - TERRESTRIAL</a>	MINOR TERRESTRIAL	A subset of the MINOR habitat containing only terrestrial organisms.		
<a href="#">AMERICAN ROBIN (TR)</a>	<a href="#">AMERICAN WOODCOCK (TR)</a>	<a href="#">BOBWHITE QUAIL (TR)</a>	<a href="#">DEER MOUSE (TR)</a>	<a href="#">DESERT SHREW (TR)</a>	<a href="#">EASTERN COTTONTAIL (TR)</a>
<a href="#">LEAST SHREW (TR)</a>	<a href="#">MOURNING DOVE (TR)</a>	<a href="#">NINE-BANDED ARMADILLO (TR)</a>	<a href="#">NORTHERN CARDINAL (TR)</a>	<a href="#">RACCOON TERRESTRIAL (TR)</a>	<a href="#">RED FOX (TR)</a>
<a href="#">RED-TAILED HAWK (TR)</a>	<a href="#">SOUTHERN SHORT-TAILED SHREW (TR)</a>	<a href="#">TEXAS RAT SNAKE (TR)</a>	<a href="#">VIRGINIA OPOSSUM (TR)</a>	<a href="#">WHITE FOOTED MOUSE (TR)</a>	
▶	<a href="#">SHORTGRASS PRAIRIE</a>	SHORTGRASS PRAIRIE	Native shortgrass prairie features blue grama, buffalograss, and fringed sage, and mixed grass areas; also includes sandsage prairies and Shinnery sands areas. One of the most remarkable ecological features in this habitat is playas - ephemeral freshwater shallow circular-shaped wetlands, most more than 15 acres in size that are primarily filled by rainfall. Example: Texas High Plains.		

1. PLANNING
2. PROBLEM FORMULATION
3. **ANALYSIS**
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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- *Analysis of exposure*
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## Representative Receptors

Selected Representative receptors for Moon Creek sediment:



Receptor	Lead Avg-TRV PCL (mg/kg)	Zinc Avg-TRV PCL (mg/kg)	TPAHs Avg-TRV PCL (mg/kg)
<b>EPC (mg/kg):</b>	<b>53.29</b>	<b>191.7</b>	<b>6.93</b>
Belted kingfisher	206.53	NA	NA
Marsh wren	183.80	361	20.80
Red-winged blackbird	NA	918	26.89
Snowy egret	206.56	NA	NA
Spotted sandpiper	108.88	325	20.04
White-faced ibis	41.39	135.38	NA



1. PLANNING
2. PROBLEM FORMULATION
3. **ANALYSIS**
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT

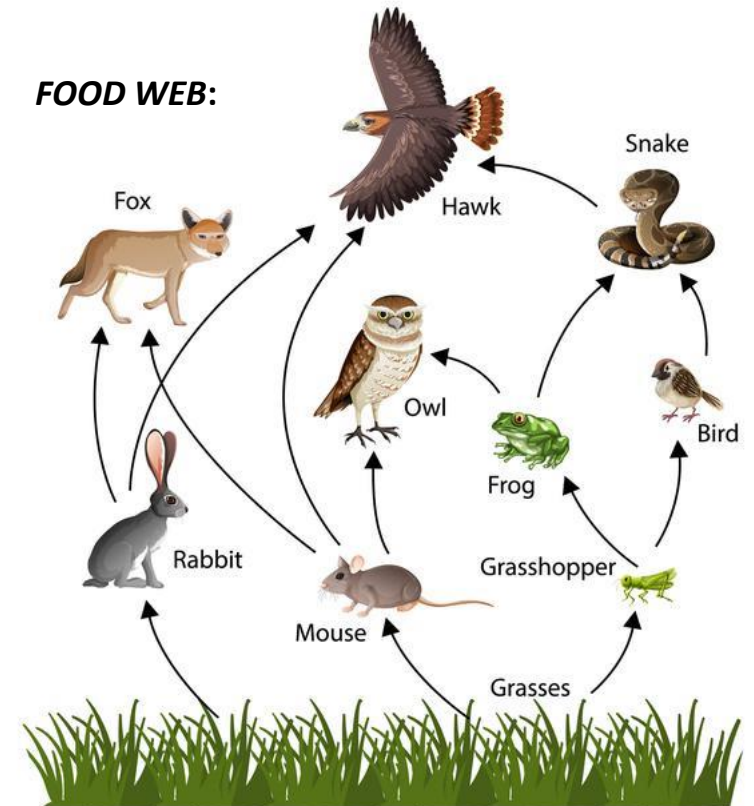


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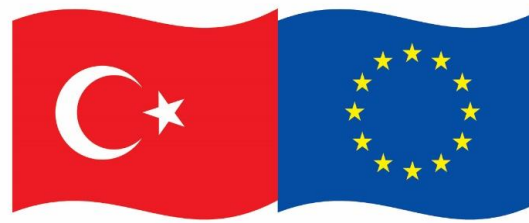
- **Analysis of exposure**
- **Analysis of effects**

## Exposure Pathway

- Exposure: Contact between a stressor and a receptor
- Pathway mechanisms for chemical stressors:
  - » By air current
  - » In surface water (rivers, lakes, streams)
  - » Over soil surface and/or through soil
  - » Through groundwater
  - » Through the food web



1. PLANNING
2. PROBLEM FORMULATION
3. **ANALYSIS**
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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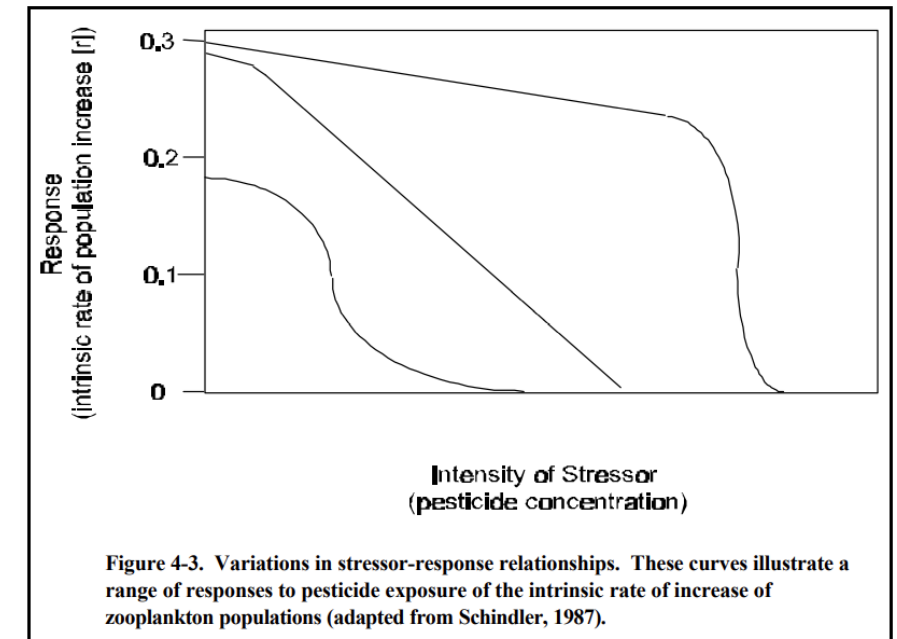
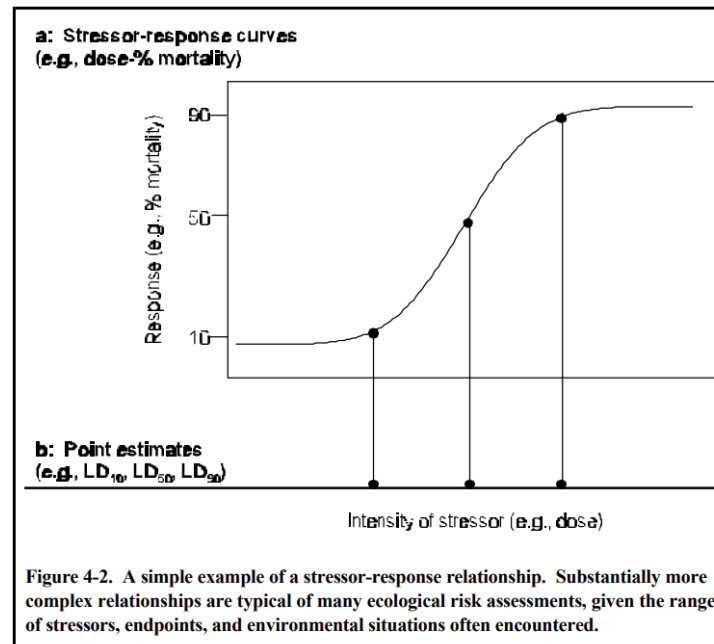
- *Analysis of exposure*
- *Analysis of effects*

## Stressor-Response Analysis and Profile

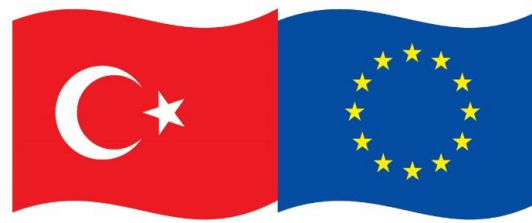
- Stressor-Response analysis: Examines relationship between stressor level and ecological effect – for example:



Stressor-Response  
profile



1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT





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- Analysis of exposure
- Analysis of effects

## Analysis of Effects

- If available, databases of parameters characterizing ecological risks for selected representative species can be used to characterize exposure pathways and exposure effects





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### Protective Concentration Levels Calculator

User: Guest  
Role: Guest

Habitat: none

Chemical: POLYCYCLIC AROMATIC HYDROCARBONS, TOTAL(CAS: 130498-29-2)

Log K<sub>ow</sub>: 0

swqb: See Toxicological Profile

BAF - soil to plant:

BAF - soil to earthworm:

BAF - soil to arthropod:

BAF - soil to wildlife:

BAF - sediment to fish:

BAF - sediment to benthic invertebrate:

Species	Body Wt.	BAF	Food IR	Water IR	Soil Sed IR	End-point	Literature NOAEL	Literature LOAEL	Literature LD 50	Surrogate Used	Conservative PCL	TRV NOAEL	TRV LOAEL	Average TRV PCL	AUF %	EF %	Other EMF	Refined PCL
AMERICAN ROBIN (TR)	0.0773	<input style="background-color: #ADD8E6;" type="text" value="2.92"/>	<input type="text" value="0.242"/>	<input type="text" value="0.13733"/>	<input style="background-color: #ADD8E6;" type="text" value="0.012584"/>	GROW	<input type="text"/>	<input type="text"/>	<input type="text"/>	STARLING	<input style="border: 2px solid red;" type="text" value="2.7807"/>	2	20	15.294				0
						MORT	<input type="text"/>	<input type="text"/>	<input type="text"/>	STARLING	27.807	20	200	152.94	<input type="text" value="100"/>	<input type="text" value="100"/>	<input type="text" value="100"/>	0
						REPR	<input type="text"/>	<input type="text"/>	<input type="text"/>	--	-	-	-	-				0

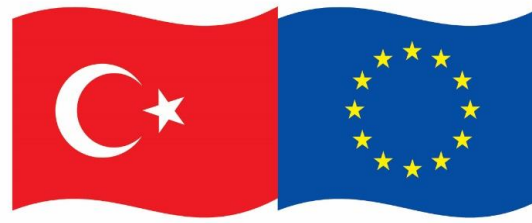
TRW – Toxicity reference Value

NOAEL - No Observed Adverse Effect Level

LOAEL - Lowest Observed Adverse Effect Level



1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. **RISK CHARACTERIZATION**
5. RISK MANAGEMENT



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# Risk Characterization

- Final phase of ecological risk assessment
- Protective concentration levels (PCL) development

## PCL Calculator

Source:

[https://pcl.wtamu.edu/pcl/PCL\\_Calculator.jsp](https://pcl.wtamu.edu/pcl/PCL_Calculator.jsp)

The screenshot shows the 'Protective Concentration Levels Calculator' web application. At the top, there are logos for West Texas A&M University and TCEQ. The user is logged in as 'Guest'. The application has tabs for 'PCL Calculator', 'Chemicals', 'Species', 'Habitat', and 'Contact Us'. The 'PCL Calculator' tab is active, showing three steps: Step 1 (Select desired habitat or select from the species list), Step 2 (Select either the chemical name or CAS), and Step 3 (Click 'Next' to compute PCLs). In Step 1, 'Habitat' is selected. In Step 2, 'Chemical: 87-86-5' is entered, and 'PENTACHLOROPHENOL' is selected from a list. In Step 3, the 'Next' button is visible.

1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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## FATE AND TRANSPORT/TOXICOLOGICAL PROFILE FOR PENTACHLOROPHENOL (PCP)

CASRN: 87-86-5

### Environmental Fate and Transport (all)

#### Sources

Pentachlorophenol's production and use in poles, cross arms, and fence posts, and other applications may result in its release to the environment.

#### Transport and Fate

**TERRESTRIAL FATE:** Results of an environmental fate study of pentachlorophenol partitions mainly in soil, water, and air. The value of 4.70 (2), its adsorptivity will be low in sandy soils, and 25,000 for the loam soils, respectively, and 25,000 for the clayey soils. Pentachlorophenol is expected to have low mobility in the soil. A survey of 4 RCRA sites that contained water contamination indicated that all had some groundwater contamination.

### Toxicity Reference Values

#### Birds

CASRN: 87-86-5

**Chemical Form:** PENTACHLOROPHENOL

**Surrogate:** CHICKEN

**Effect Type:** GROWTH

**Effect Measure:** BODY WEIGHT

**NOAEL:** 6.73 mg/kg-d

**LOAEL:** 67.3 mg/kg-d

**Body Weight:** 0.6584 kg (from study; Stedman et al. 1980)

**Food Ingestion Rate:** 0.04434 kg/d (assumed; EPA 2007b)

**Dosing Regime:** *Ad libitum* in diet; four dose levels (0, 1, 10, 100, and 1,000 mg/kg diet) on unmeasured concentrations

**Age of Test Animal:** 1 d

**Life Stage and Sex:** Juvenile / NR

**Exposure Duration:** 1 w

**Uncertainty Factors:** N/A

#### Conversions:

**NOAEL:**  $(100 \text{ mg PCP/kg food} \times 0.04434 \text{ kg/d}) / 0.6584 \text{ kg BW} = 6.73 \text{ mg/kg-d}$

**LOAEL:**  $(1,000 \text{ mg PCP/kg food} \times 0.04434 \text{ kg/d}) / 0.6584 \text{ kg BW} = 67.3 \text{ mg/kg-d}$

**End Point Reference:** Stedman et al. (1980); EPA (2007b)

**Basis for Selection/Comments:** EPA (2007b) Eco-SSLs contain 2 studies which report both a NOAEL and LOAEL for avian growth. TRVs from Stedman et al. (1980) were chosen because they were based on growth data.

#### Mammals

CASRN: 87-86-5

**Chemical Form:** PENTACHLOROPHENOL

**Surrogate:** RAT

**Effect Type:** GROWTH

**Effect Measure:** BODY WEIGHT CHANGES

**NOAEL:** 4.95 mg/kg-d

**LOAEL:** 47.7 mg/kg-d

**Body Weight:** 0.5580 kg (from study; Kimbrough and Linder 1978)

**Food Ingestion Rate:** 0.07168 kg/d (from study; Kimbrough and Linder 1978)

**Dosing Regime:** *Ad libitum* in diet; three dose levels (0, 0.9, 5, and 28 mg/kg-d)

**Age of Test Animal:** NR

**Life Stage and Sex:** Juvenile / Males

**Exposure Duration:** 220 d

**Uncertainty Factors:** N/A

**Conversions:** N/A

**End Point Reference:** Kimbrough and Linder (1978); EPA (2007b)

**Basis for Selection/Comments:** EPA (2007b) Appendix 6.1 contains 7 studies which report both a NOAEL and LOAEL for mammalian reproduction. The average of each NOAEL-LOAEL pair was calculated, and the median of these values was chosen. Note: conversions from concentration to dose were performed by EPA (2007b) and confirmed by WTAMU.

CASRN: 87-86-5

**Chemical Form:** PENTACHLOROPHENOL

**Surrogate:** RAT

NOAEL - No observed adverse effect level  
LOAEL - Lowest observed adverse effect level

1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
- 4. RISK CHARACTERIZATION**
5. RISK MANAGEMENT



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## PCLs calculation

General equation form used to calculate protective concentration levels (PCLs) for wildlife receptors:

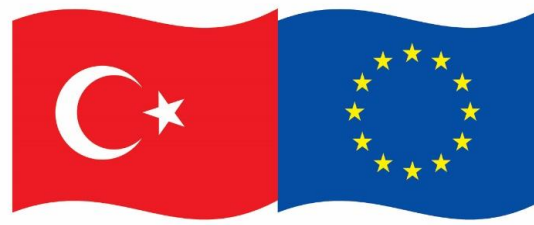
$$PCL_{soil/sediment} = \frac{TRV}{(BAF \times FIR) + SSIR}$$

- $PCL_{soil/sediment}$  ..... Protective concentration level for soil or sediment (mg/kg dry weight)
- TRV ..... Toxicity reference value of the chemical (mg/kg-day)
- BAF ..... Bioaccumulation factor
- FIR ..... Food ingestion rate (kg/kg BW - day)
- SSIR ..... Soil or sediment ingestion rate (kg/kg BW - day)

Inputs can be taken from the TCEQ database ( <https://www.tceq.texas.gov/remediation/trrp/trrppcls.html> ) or other sources.



1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. **RISK CHARACTERIZATION**
5. RISK MANAGEMENT



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## PCLs calculation

- In available databases, Conservative PCLs for individual species are presented





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### Protective Concentration Levels Calculator

User: Guest  
Role: Guest

Habitat: none

Chemical: POLYCYCLIC AROMATIC HYDROCARBONS, TOTAL(CAS: 130498-29-2)

Log K<sub>ow</sub>: 0

swqb: See Toxicological Profile

BAF - soil to plant:

BAF - soil to earthworm:

BAF - soil to arthropod:

BAF - soil to wildlife:

BAF - sediment to fish:

BAF - sediment to benthic invertebrate:

Species	Body Wt.	BAF	Food IR	Water IR	Soil Sed IR	End-point	Literature NOAEL	Literature LOAEL	Literature LD 50	Surrogate Used	Conservative PCL	TRV NOAEL	TRV LOAEL	Average TRV PCL	AUF %	EF %	Other EMF	Refined PCL
AMERICAN ROBIN (TR)	0.0773	2.92	0.242	0.13733	0.012584	GROW	<input type="text"/>	<input type="text"/>	<input type="text"/>	STARLING	2.7807	2	20	15.294				0
		MORT	<input type="text"/>	<input type="text"/>	<input type="text"/>	STARLING	27.807	20	200	152.94	<input type="text" value="100"/>	<input type="text" value="100"/>	<input type="text" value="100"/>	0				
		REPR	<input type="text"/>	<input type="text"/>	<input type="text"/>	--	-	-	-	0								

1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. RISK CHARACTERIZATION
5. RISK MANAGEMENT



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Exposure Point  
Concentrations  
(EPCs) for Wetland  
sediment against  
PCLs of wetland  
sediment-based  
receptors

Receptor	Cadmium PCL (mg/kg)	Copper PCL (mg/kg)	Zinc PCL (mg/kg)	PCP PCL (mg/kg)	TPAHs PCL (mg/kg)	TCDD TEQ (Avian) PCL (mg/kg)	TCDD TEQ (Mammal) PCL (mg/kg)
<b>EPC (mg/kg):</b>	<b>3.34</b>	<b>131.6</b>	<b>335.1</b>	<b>0.62</b>	<b>27.95</b>	<b>3.5E-06</b>	<b>3.3E-06</b>
American mink	47.37	168.56	12834	6.18	394.00	NA	3.6E-05
American wigeon	16.32	1868	459	14.27	11.22	3.8E-03	NA
Black-crowned night heron	18.44	468	304.44	4.57	17.48	6.1E-05	NA
Cottonmouth water moccasin	20.39	793	587	7.12	158.27	7.6E-05	NA
Green heron	45.61	1307	1108	10.43	69.28	1.4E-04	NA
Mallard	19.85	1053	387	10.50	12.64	2.5E-04	NA
Marsh rice rat	16.12	542	1858	3.03	36.08	NA	2.0E-05
Marsh wren	6.80	143.02	71.86	1.79	3.78	2.4E-05	NA
Muskrat	36.67	5216	9211	18.49	99.21	NA	3.4E-03
Plain-bellied water snake	20.72	686	914	4.93	97.02	6.5E-05	NA
Raccoon Semi-Aquatic	50.92	1303	5179	8.14	126.98	NA	4.6E-05
Red-winged blackbird	6.95	551	182.94	5.94	4.89	1.9E-03	NA
Snapping turtle	24.64	533	277.32	6.29	14.63	8.3E-05	NA
Snowy egret	14.00	462	594	3.43	64.01	4.6E-05	NA
Spiny softshell turtle	26.58	675	439	6.58	25.17	8.7E-05	NA
Spotted sandpiper	5.70	125.65	64.75	1.79	3.64	2.2E-05	NA
Swamp rabbit	29.64	3477	7175	15.89	84.27	NA	9.7E-04
Virginia opossum	40.07	1898	8459	29.00	190.62	NA	NA
White-faced ibis	11.91	262.73	135.38	3.75	7.62	4.7E-05	NA
Yellow-crowned night heron	53.22	1094	543	12.95	27.72	1.7E-04	NA
Yellow mud turtle	21.33	512	259.80	5.89	12.91	8.1E-05	NA

1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. **RISK CHARACTERIZATION**
5. RISK MANAGEMENT



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Exposure point  
concentrations  
for the  
sediment  
compared to  
the default  
benthic PCLs

Analyte	Area	EPC (mg/kg)	Sediment Benthic PCL (mg/kg)	Benthic Community COC?
Cadmium	Moon Creek	0.94	2.99	No - EPC < PCL
Chromium	Moon Creek	32.90	77.2	No - EPC < PCL
Copper	Moon Creek	34.94	90.3	No - EPC < PCL
Lead	Moon Creek	53.29	81.9	No - EPC < PCL
Zinc	Moon Creek	191.7	290	No - EPC < PCL
Pentachlorophenol	Moon Creek	0.56	1.2	No - EPC < PCL
TPAHs	Moon Creek	6.93	12.2	No - EPC < PCL
TCDD TEQ (Avian)	Moon Creek	2.1E-06	NA	See Uncertainty Analysis
TCDD TEQ (Mammal)	Moon Creek	2.2E-06	NA	See Uncertainty Analysis
Cadmium	Wetlands	3.34	2.98	Yes - EPC > PCL
Copper	Wetlands	131.60	90.3	Yes - EPC > PCL
Zinc	Wetlands	335.10	290	Yes - EPC > PCL
Pentachlorophenol	Wetlands	0.62	1.2	No - EPC < PCL
Total PAHs	Wetlands	27.95	12.2	Yes - EPC > PCL
TCDD TEQ (Avian)	Wetlands	3.5E-06	NA	See Uncertainty Analysis
TCDD TEQ (Mammal)	Wetlands	3.3E-06	NA	See Uncertainty Analysis



1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. **RISK CHARACTERIZATION**
5. RISK MANAGEMENT



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## Unacceptable Risk

Unacceptable risk to benthics and wildlife were identified only in wetland sediment:

Analyte	Sediment Wetland EPC (mg/kg)	Final Sediment PCL (mg/kg)	Receptors at Risk
Cadmium	3.34	2.99	Benthics
Copper	131.6	90.3	Benthics
Zinc	335.1	290	Benthics, spotted sandpiper
TPAHs	27.95	12.2	Benthics, spotted sandpiper, marsh wren, red-winged blackbird

1. PLANNING
2. PROBLEM FORMULATION
3. ANALYSIS
4. RISK CHARACTERIZATION
5. **RISK MANAGEMENT**



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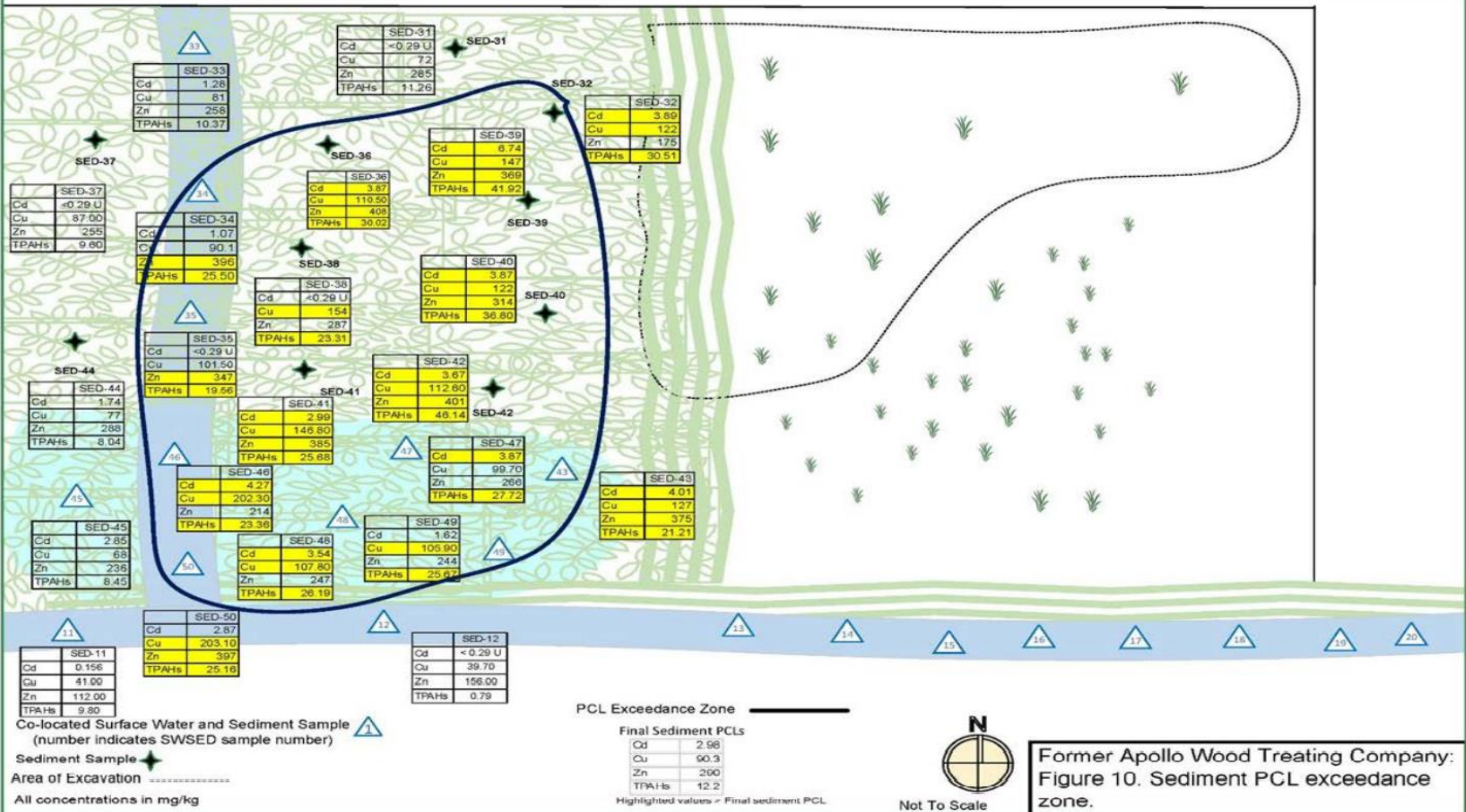
## Risk Management

### Risk Management of Terrestrial Habitat

- Hot spot removal (excavation and backfilling with clean soil)
- Ecological PCLs are not required for surface soil
- Prior to hot spot removal, human health RA is recommended to determine soil PCLs for the site

### Risk Management of Aquatic Habitat

- Unacceptable ecological risk in the wetland sediments are from: Cd, Cu, Zn and TPAHs
- Removal action within the wetland would severely impact many other wildlife receptors ⇒  
Conducting of remediation Feasibility study is recommended rather than excavation
- No unacceptable ecological risks are associated with contamination of the riparian areas, Moon Creek surface water/sediment and wetland surface water.







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THANK YOU...