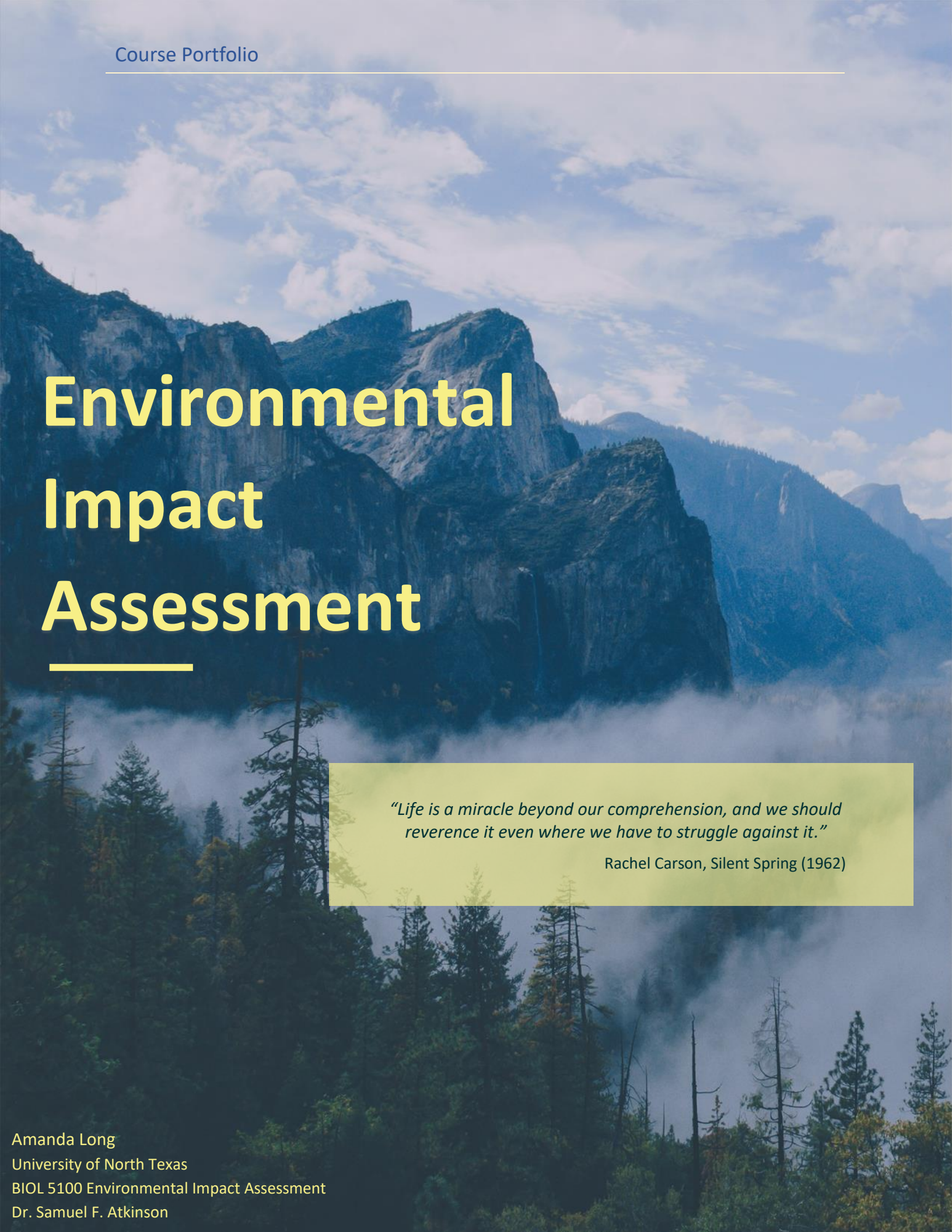

Environmental Impact Assessment

"Life is a miracle beyond our comprehension, and we should reverence it even where we have to struggle against it."

Rachel Carson, Silent Spring (1962)

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Introduction

BIOL 5100 Environmental Impact Assessment (EIA)

The purpose of the BIOL 5100 EIA Course Portfolio was to compile original and improved versions of assignments to highlight accomplishments throughout the semester while evaluating strengths and weaknesses. However, this portfolio only includes the final improved versions.

**Note*, the original version is available upon request.

This portfolio shows competency and measures of mastery of ten primary subjects relative to an EIA. Competency assignments aimed to develop the necessary knowledge and skills for the primary subjects of EIA. In contrast, as "*you never know a subject better than when you are expected to teach someone that subject,*" mastery assignments required the development of questions in such a manner that they can be used to teach with an answer key for future graders. When applicable, I developed scenarios for the state of Michigan, as I will build my career here.

The EIA course covered the principles and practices of preparing environmental impact statements and assessments. During the course, I learned how to interpret the impacts that projects, plans, and policies have on environments as well as the resultant impacts on resources, ecosystems, and communities. I examined the methodologies for identifying impacts, describing affected environments, predicting and assessing impacts, and selecting a proposed action from a group of alternative actions that meets a specific need.

Throughout the course, I gained the knowledge of:

- The history of the National Environmental Policy Act (NEPA) and key features.
- Interpreting the Council on Environmental Quality (CEQ) Regulations requiring agencies compliance with NEPA.
- The six steps satisfying the requirement to assess proposed actions and the potential environmental impacts from federal agencies or non-federal actions requiring federal permits.
- Predicting the degree of environmental impacts to occur on the physical, chemical, or biological environments resulting from hypothetical proposed actions.
- Determining if predicted levels of environmental impacts are significant based on CEQ regulations.
- Selecting a preferred alternative between the reasonable alternatives meeting the purpose and need initating the proposed action.

Introduction

The objectives of Subject Matter 1 explained the history of the National Environmental Policy Act of 1969 (NEPA) and key components and the key terms and concepts of the regulations that agencies utilize for compliance with NEPA.

The launch of the environmental movement eventually led to the National Environmental Policy Act of 1969 (NEPA) to regulate the impact of federal agencies proposed actions on the environment. Specifically, as NEPA aimed to (1) declare national policy encouraging harmony among man and the environment, (2) promote efforts preventing or eliminating environmental damages and stimulate human health and welfare, (3) enrich the understanding of ecosystems and natural resources, and (4) establish a Council on Environmental Quality (CEQ). In the Executive Office of the President, the CEQ oversees federal agencies and departments to ensure NEPA is implemented. CEQ regulations govern Environmental Impact Statements (EIS) and developed a set of the 40 most asked questions to direct agencies.

Competency Assignment

Describe (25 to 50 words each) how the following five terms or phrases are defined in the CEQ regulations, and provide a statement as to whether you believe those terms adequately convey congressional intent of developing national goals of environmental policy and why. Part 1508 of the CEQ regulations (Terminology and Index) should provide a useful starting point.

1. Purpose and Need
2. Categorical Exclusion
3. Environmental Assessment
4. Environmental Impact Statement
5. Significance

Mastery Assignment

Select, review and summarize in your own words two additional terms which were not covered in the Subject 1 Competency assignment. Develop an exam-like short-answer essay question for each of your selected terms or phrases (25 to 50 words each) specifically related to environmental assessment that are utilized in NEPA or the CEQ regulations. Prepare a typical short-answer essay response (25 to 50 words each) to each question that could be used as a guideline for future graders of the question. CEQ's Forty most Asked Questions should provide a useful starting point for this assignment.

§1502.13 Purpose and Need

A concise description in an environmental impact statement of an agencies purpose and need for an alternative proposition of the proposed action.

§1508.4 Categorical Exclusion

Categorical exclusions are actions with no impact on human environments as well as procedures thus excluding the need for an environmental assessment or environmental impact statement.

§1508.9 Environmental Assessment

An environmental assessment is a public document providing evidence and analyses assessing the resulting impacts an action put forth may or may not have on the environment which conveys congressional intent as it works to prevent environmental damages.

§1508.11 Environmental Impact Statement

An environmental impact statement utilized in planning and decisions by federal officials enforces and ensures NEPA policies are carried out by federal agencies by stating potential impacts on the quality of human environments thus minimizing environmental damages.

§1508.27 Significantly

Significance considers context by analyzing an action in varying settings such as a whole society, affected regions, interests, and locality while intensity considers the intensity of the resulting impact. Significance conveys intent as it analyzes the entirety of a proposed action by assessing it under varying settings as well as the severity of prospective resulting impacts.

Question

Human environment (§1508.14 Human environment) relates the relationship between humans with the natural and physical environment thus societal components do not require environmental impact statements. What is the difference between the relationship of humans with the natural environment and the relationship of humans with the physical environment?

Answer

The relationship of humans with the natural environment pertains to ecological components of the environment of the structuring and functioning of ecological systems as well as natural resources whereas the relationship of humans with the physical environment pertains to the impacts and uses of the Earth's land, water, air, and organisms.

Question

How does mitigation (§1508.20 Mitigation) ensure environmental protections in environmental assessments?

Answer

Mitigations identify the resulting impacts of a given proposal or action. In doing so, mitigation avoids actions of negatively resulting impacts, limit the intensity of resulting actions, repair, rehabilitate, or store environmental conditions, preserve and maintain temporal impacts, and/or substituting resources to compensate for resulting negative impacts.

Introduction

The objectives of subject matter 2 were to interpret NEPA's mandates for topics to be included in an EIS and the CEQ regulations for formatting, and how to plan an environmental assessment by describing or diagraming the relationship among legislation, regulations, and Canter's conceptual model.

An Environmental Impact Assessment (EIA) is the first step of compliance with NEPA to identify the impact an action will have through scoping. Canter's ten step process aids in focusing the process of planning an EA if a proposed action is found to have significant impacts on the environment. In contrast, if a finding of no significant impact (FONSI) is found, an agency does not have to move forward with an EA.

Competency

The National Environmental Policy Act (NEPA) mandates that five (5) topics must be included in an Environmental Impact Statement (EIS). The Council on Environmental Quality (CEQ) has regulations that strongly suggest the format of an EIS that include those five topics. Canter suggests that there are ten (10) activities involved in planning an environmental assessment. Describe the relationship between NEPA's five topics, CEQ's formatting regulations, and Canter's ten activities (250 to 500 words) or develop a flowchart/schematic that illustrates the relationship (1-page maximum graphic).

Mastery

Using NEPA's five topics that are required in an EIS, CEQ's regulations on the format of an EIS, Canter's textbook chapter on planning an assessment, and any additional sources that you find relevant (be sure to provide full citations to any additional sources you use), develop an exam-like short-answer essay question that asks an insightful question related to planning an environmental assessment (100 to 200 words). Prepare a typical short-answer essay response (100 to 200 words) that could be used as a guideline for future graders of the question.

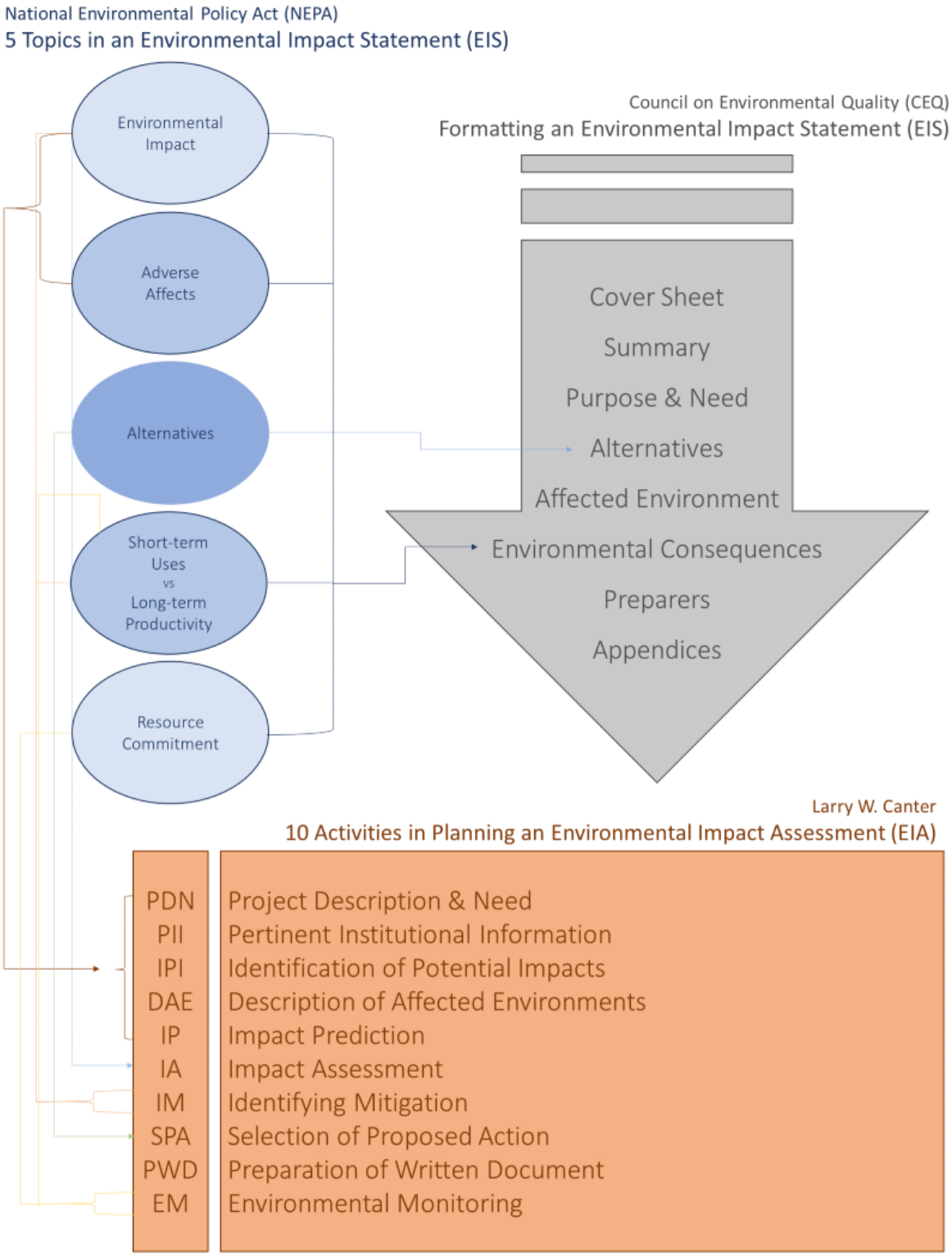


Figure 1. Flow chart depicting the relationship between the five topics the National Environmental Policy Act mandates to be included in an Environmental Impact Statement (EIS), the regulations the Council on Environmental Quality suggests when formatting an EIS comprised of the five topics, and Canter's ten activities involved in planning an Environmental Impact Assessment.

Question

When preparing an environmental impact statement (EIS), Canter's Table 2.1 "Checklist for EIS Preparation" is comprised of checklist sections for preliminary activities, scoping, drafting EIS, final EIS, and a record of decision with two blank columns next to each section titled "Scheduled date" and "Actual date" to be handed out and filled out anytime an impact statement is in the works. What is the importance of this table, and what is the importance of adding a third column titled "Team member"?

Answer

Filling out the two blank columns on Canter's Table 2.1 "Checklist for EIS Preparation" titled "Scheduled date" and "Actual date" ensures the entire team will stay focused on their upcoming deadlines rather than slacking off whereas the importance of adding a third blank column "Team member" further ensures that not only the team will stay on track but that an individual assigned particular work will follow through on their deadlines and tasks as it acts as a reminder for responsibilities and thus pressures individuals to complete tasks in a timely manner. As such, it's important to add the column "Team member" to table 2.1 to indicate which team member is responsible with their name. Overall, Table 2.1 "Checklist for EIS Preparation" should always be passed out when working on impact statement as it not only ensures teams to stay on track but initially organizes the project by divvying up the workload and is an easily accessible document to be reminded of who is in charge of what.

Introduction

The objectives of Subject Matter 3 were to describe and distinguish the variation between the three major methodologies applicable for identifying proposed actions and the associated potential types of environmental impacts.

"Methodology" implies a structured process to accomplish at least one of Canter's ten environmental assessment planning activities described in subject matter 2. Methodologies are comprised of three broad categories, interaction matrices, networks, and checklist for data presentation and collection. Understanding types of methods allows for selecting and using a methodology for specific impact studies. Methodologies can also be adapted to meet the need of specific study scopes.

Competency Assignment

Briefly describe, compare and contrast matrices (simple and stepped), networks, and checklists (simple and descriptive) for identifying the potential environmental impacts that may be induced by a project, plan, policy or permit? (500 to 1000 words, plus any figures or tables that you feel appropriate, 3 pages maximum length.)

Mastery Assignment

Using Canter's textbook chapter on methods for impact identification, and any additional sources that you find relevant (be sure to provide full citations to any additional sources you use), develop an exam-like short-answer essay question that asks an insightful question related to methodologies for identifying potential impacts (100 to 200 words). Prepare a typical short-answer essay response (100 to 200 words) that could be used as a guideline for future graders of the question.

Methods of simple interaction matrices are comprised of a spreadsheet to determine the potential interactions between a project and the environment by marking where an impact is expected and then scaled 1-10 in magnitude and importance, 10 being the highest and 1 being the lowest. In contrast, stepped matrices are utilized to identify potential impacts between environmental factors and environmental factors at the secondary and tertiary level, allow for tracing impacts, and functions as an intermediate step between networks and simple matrices. The methodology of networks function to identify the relationship between actions and the potential environmental variables to be impacted at the primary, secondary, and tertiary levels by combining the causes and consequences of potential impacts. Methods for checklists are either simple or descriptive. Simple checklists are comprised of environmental variables to be considered but don't specify data required, measurement methods, or predictions and assessments of impacts. In contrast, descriptive checklists are comprised of listing environmental variables with measurements and predictions and assessments of impacts. Simple checklists are implemented to plan and summarize an environmental impact statement by systemizing the methods whereas descriptive checklists are implemented for studies of environmental impacts.

It is important to identify the correct methodology when identifying the potential environmental impacts resulting from a project, plan, permit, or policy to achieve the greatest value throughout the activities comprising an impact assessment. Specifically, table 1 summarizes the practicality of implementing each method per the activities involved in the methods of an environmental impact assessment.

Table 1. The feasibility of utilizing each methodology when identifying impacts of an action for an Environmental Impact Assessment (EIA) ranked by high, medium, or low practicality.

Methodology	Activity	Practicality
Simple Matrices	Identifying impact	High
	Impacted environment described	Low
	Predicted impact and assessment	Medium
	Proposed action selected	Medium
	Summarization and communication of study	High
Stepped Matrices	Identifying impact	Medium
	Impacted environment described	
	Predicted impact and assessment	Medium
	Proposed action selected	Low
	Summarization and communication of study	Low
Networks	Identifying impact	High
	Impacted environment described	
	Predicted impact and assessment	Medium
	Proposed action selected	
	Summarization and communication of study	
Simple Checklists	Identifying impact	Medium
	Impacted environment described	High
	Predicted impact and assessment	Medium
	Proposed action selected	
	Summarization and communication of study	Medium
Descriptive Checklists	Identifying impact	Medium
	Impacted environment described	
	Predicted impact and assessment	High
	Proposed action selected	
	Summarization and communication of study	

Question

Methodologies for identifying potential impacts provide a useful tool throughout the process of developing an impact assessment although they are not required. Furthermore, there is no methodological absolute answer to the questions associated with potential projects or alternative actions and there is no universal methodology to apply while developing an environmental assessment due to the variation in proposed project types and all of the environmental conditions. Despite this, what is the usefulness of utilizing methodologies during the environmental impact assessment process?

Answer

When developing an impact assessment and identifying potential impacts, methodologies guarantee the inclusion of all relevant environmental factors in a prospective study as methodologies are comprised of 50 - 1,000 environmental variables and assist in developing studies in areas lacking pertinent environmental data. Utilizing methods allow for a common ground to synthesizing information, evaluating alternative actions, and evaluating costs of impact-mitigation. Some methodologies aid in portraying and communicating relative information in a receptive manner. Thus, some methodologies summarize impact information. Lastly, methodologies aid in fulfilling the requirements of the National Environmental Protection Act (NEPA) to use steps and procedures guaranteeing adequate considerations and decisions are put forth when identifying impacts.

Introduction

The objectives for subject matter 4 were to apply CEQ regulations describing the affected environment to interpret existing environmental data and complete a portion of a description of existing environment.

The CEQ regulations require a description of the affected environment of the area(s) at which will be impacted by a proposed action and all of the reasonable alternatives considered, including no action. Describing the affected environment includes the physical environments, biological, and human resources. Initial factors are to apply general agency guidelines or regulations, professional knowledge of the area or project, review of EISs or EAs for geographic area or project, and general or specific project methodologies to describe the affected environment.

Competency Assignment

Use the Environmental Protection Agency's EnviroAtlas interactive database to explore environmental data associated with a community (any community that has "High Resolution" data (e.g. Austin, Texas, Portland, Oregon, etc. - there are 30 U.S. communities with high resolution data). Envision some type of a proposed action that you are interested in (e.g. building a bridge, restoring a wetland, removing an old dam, building a new Space Force training center - use your imagination). Assume that this envisioned action has been proposed near your community. Next, select an environmental factor that (1) could be impacted by the proposed action, and (2) is reported for your selected community. Finally, briefly describe the existing conditions of that environmental factor. Be sure to begin the description with the project type and the name of the community you selected, and then provide a description of the existing conditions of the environmental factor. Include a proper citation to the source of data.

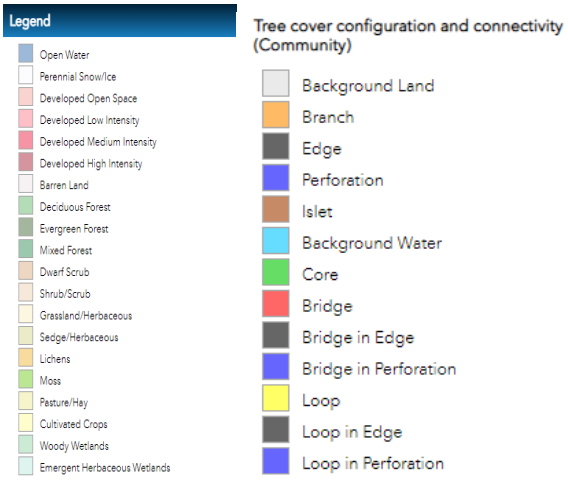
Mastery Assignment

Using Canter’s textbook chapter on describing the affected environment, and any additional sources that you find relevant (be sure to provide full citations to any additional sources you use), develop an exam-like short-answer essay question that asks an insightful question related to describing the affected environment (100 to 200 words). Prepare a typical short-answer essay response (100 to 200 words) that could be used as a guideline for future graders of the question.

Designing and constructing a 1.5 km conservation corridor (i.e., wildlife crossing structure) East of Mountain Dell Reservoir over Highway 80 in Salt Lake City, Utah. Specifically, to connect areas of forest patches with a wildlife crossing structure comprised of similar vegetative cover to provide quality habitat for terrestrial species spanning 1.5 km over an area of high to medium urban density (Figure 1). The existing tree cover configuration of the surrounding area at which the wildlife crossing would open and end at is comprised of dense core forest areas with high levels of connectivity on either side of the highway. Currently, the surrounding tree cover and connectedness has high levels of connectivity which indicates it is a good location to build a wildlife crossing. But, the tree cover and configuration specifically located where the structure will go will be the most impacted until the trees and surrounding vegetative cover regrow.

The resultant wildlife crossing structure will enhance the connectedness of the landscape as it provides an area for safe crossing and will reduce the likelihood of human-wildlife interactions and fatalities. The existing environmental conditions to be impacted by the proposed conservation corridor would be the configuration and connectivity of tree cover (Figure 1). Specifically, the areas of bridge (Figure 1) being prospective areas targeted for ecological restoration or conservation. The conservation corridor would result in bridging two core areas on each end.

Figure 1. The proposed wildlife crossing to be built over Highway 80 in Salt Lake City, Utah between two locations comprised of high, dense tree cover configuration and connectivity.



Question

As there are a variety of components and steps when preparing and starting to write an Environmental Impact Statement (EIS), it can be good practice to often begin with the easiest thing for you to write first. Say you are given the task to start writing up an EIS and you are to start with the easiest task first, in this case it is the description of the affected environment. What are the pros and cons of starting an EIS with the easiest task first? Specifically, regarding the pros of starting with the interesting description of the environmental setting while keeping the CEQ regulations in mind.

Answer

When starting the writing process of an Environmental Impact Statement (EIS) with the easiest task first, in this case describing the affected environment, the educational process of learning and understanding the affected area and its history, as well as the details of the natural resources that could be impacted, is in some cases the most interesting component of an EIS for an individual to assess and write. Yet, one could unintentionally get carried away in the writing and expend all of their energy on the easiest chapter. Furthermore, the CEQ regulations state the description of the environmental setting in an EIS should be brief and that the actual description should not be longer than what is necessary to actually report the findings. Thus, one must take careful precaution in what they choose to write about when describing an affected environment and the energy that they expend when writing and working on this particular section.

Introduction

The objectives for Subject Matter 5 are to apply the National Sanitation Foundation's Water Quality Index to a hypothetical dataset of water quality and utilize the index to interpret the quality of the hypothetical river.

Environmental indices (EI) are comprised of large quantities of descriptive categorization or numerical environmental data or information. As such, environmental indices examine existing conditions (i.e., quality) of environmental resources or predict the future quality of environmental resources if a proposed action is to be implemented. EIs are used to summarize existing data, communicate information on the quality of the baseline environment impacted, assess an environments susceptibility or vulnerability to a pollutant, focus on critical environmental factors, and determines the difference between an index with and without the project.

Competency Assignment

Use the following table containing hypothetical water quality data for a hypothetical Atkinson River, calculate the arithmetic and the geometric Water Quality Index for both average annual flow conditions and low flow conditions. Prepare a table that shows: (1) nine parameters, (2) average and low flow data, (3) sub index for each point (from NSF functional curves in Canter 1996), (4) parameter importance weight, (5) arithmetic WQI calculations, and (6) geometric WQI calculations. Highlight the final scores for the arithmetic and geometric indices, and interpret scores based on the descriptor words suggested by the NSF (very bad, bad, medium, etc.). Highlight the parameter of most concern.

Parameter	Average Annual Flow Conditions	Low Flow Conditions
Dissolved Oxygen (% saturation)	70	40
Fecal Coliforms (no./100ml)	4	300
pH (standard units)	6.5	6
BOD5 (mg/L)	2	4
Nitrates (mg/L)	5	11
Phosphates (mg/L)	1.5	2
Temperature Deviation (°C)	no change	+5
Turbidity (JTU)	4	90
Total solids (mg/L)	75	300

Mastery Assignment

Using Canter's textbook chapter on environmental indices, and any additional sources that you find relevant, develop an exam-like question that provides water quality data (real or hypothetical) and asks that the NSF Water Quality Index be calculated that describes the quality of the water body represented (one page maximum that asks the question(s) and provides a table of data). Prepare a

correct response to your question (also a one page maximum that shows the calculations and highlights the answer(s) that could be used by future graders of the question.

Parameter	Average Annual Flow Conditions	Weight (W_i)	Subindex (I_i)	I_iW_i	I_i^{Wi}	Low Flow Conditions	Subindex (I_i)	I_iW_i	I_i^{Wi}
Dissolved Oxygen (% saturation)	70	0.17	75	12.75	2.08	40	30	5.1	1.78
Fecal Coliforms (no./100ml)	4	0.15	85	12.75	1.94	300	33	4.95	1.68
pH (standard units)	6.5	0.12	82	9.84	1.69	6	65	7.8	1.65
BOD5 (mg/L)	2	0.1	95	9.5	1.57	4	65	6.5	1.51
Nitrates (mg/L)	5	0.1	75	7.5	1.53	11	53	5.3	1.487
Phosphates (mg/L)	1.5	0.1	35	3.5	1.43	2	28	2.8	1.39
Temperature Deviation (◦C)	no change	0.1	93	9.3	1.57	5	40	4	1.44
Turbidity (JTU)	4	0.08	95	7.6	1.43	90	20	1.6	1.27
Total solids (mg/L)	75	0.08	85	6.8	1.42	300	60	4.8	1.38
				WQI_a =	WQI_m =			WQI_a =	WQI_m =
				80	77			43	40

The resultant arithmetic Water Quality Index (WQI_a) and geometric Water Quality Index (WQI_m) for the average annual flow conditions in the Atkinson River are both depicted as grey and of good quality as (WQI_a = 80) and (WQI_m = 77) fall into the category “Good” ranging from “71-90” in Table 5.6 of Canter (1996). In contrast, the low flow conditions in the Atkinson River are both depicted as yellow and of bad quality as (WQI_a = 43) and (WQI_m = 40) fall into the category “Bad” ranging from “26-50” in Table 5.6 of Canter (1996). Overall, phosphate levels (mg/L) are the parameter of most concern in the Atkinson River. Although turbidity (JTU) is the parameter of most concern during low flow conditions based on the sub index, phosphate levels have a higher weight than turbidity and as the negative impacts of turbidity (i.e., cloudy water) are debated, phosphates are of more concern in low flow conditions and of most concern during average flow conditions.

Question

Calculate the NSF arithmetic Water Quality Index (WQI_a) and geometric Water Quality Index (WQI_m) for the hypothetical average and low flow conditions for the following river. Be sure to include the weight of the parameter to the right of the column, the subindex identified from Canter (1996), and the parameters calculated for each individual parameter as well as the resultant total. Furthermore, interpret the worst parameter found between the average and low flow conditions.

Parameter	Average Flow Conditions	Low Flow Conditions
Dissolved Oxygen (% saturation)	90	30
Fecal Coliforms (no./100ml)	10	1000
pH (standard units)	7	5
BOD5 (mg/L)	5	4
Nitrates (mg/L)	10	12
Phosphates (mg/L)	1	3
Temperature Deviation (oC)	1	5
Turbidity (JTU)	5	80
Total solids (mg/L)	50	450

Answer

Parameter	Average Annual Flow Conditions	Weight (W_i)	Subindex (I_i)	I_iW_i	I_i^{Wi}	Low Flow Conditions	Subindex (I_i)	I_iW_i	I_i^{Wi}
Dissolved Oxygen (% saturation)	90	0.17	95	16.15	2.16	30	25	4.25	1.72
Fecal Coliforms (no./100ml)	10	0.15	66	9.9	1.87	1000	20	3	1.56
pH (standard units)	7	0.12	90	10.8	1.71	5	24	2.88	1.46
BOD5 (mg/L)	5	0.1	55	5.5	1.49	4	65	6.5	1.51
Nitrates (mg/L)	10	0.1	55	5.5	1.49	12	45	4.5	1.46
Phosphates (mg/L)	1	0.1	40	4	1.44	3	19	1.9	1.34
Temperature Deviation (oC)	1	0.1	90	9	1.56	5	40	4	1.44
Turbidity (JTU)	5	0.08	85	6.8	1.4	80	25	2	1.29
Total solids (mg/L)	50	0.08	85	6.8	1.4	450	40	3.2	1.34
				WQIa =	WQIm =			WQIa =	WQIm =
				74	72			32.23	29.72

The resultant water quality index calculations indicate that the overall quality of the water is significantly worse in low flow conditions in comparison to average flow conditions. This is likely due to the nature of water parameters and the impacts that the variety of parameters and the variety in resulting conditions can have. Specifically, when the river is experiencing low flow conditions, the quality of the water is more susceptible to lower levels of dissolved oxygen, higher levels of fecal coliforms, higher turbidity (i.e., cloudiness of the water), and the total level of solids. The combination of these parameters in low flow conditions in comparison to average flow conditions can indicate poor habitat quality for the species that reside in this river. We would expect to see lower levels of species richness and abundance as the low flow conditions are less suitable for species requiring high levels of dissolved oxygen. Furthermore, the higher turbidity of the river at 80 JTU paired with 450 mg/L of total solids will inevitably result in lower amounts of sunlight penetration reaching the photosynthetic organisms, and could potentially lead to hypoxic conditions in the river.

Introduction

The objectives for subject matter 6 were to diagram the six-step conceptual model for predicting and assessing potential air quality impacts of a given proposed action and to predict the concentration of an air contaminant under a given hypothetical project emission features and under specific meteorological conditions.

The Clean Air Act of 1990 regulates the air emissions within the United States air and the range of standard air quality by determining the level (i.e., amount) at which a pollutant can be present or emitted. The Air Quality Index is utilized as a baseline comparison of conditions to the predicted conditions of a proposed action. The six-step conceptual model to an air impact assessment is to (1) identify emissions and impacts of concern, (2) describe the existing air setting, (3) procure relevant air criteria, laws, and regulations, (4) predict alternatives impact on air, (5) assess air impacts significance, and (6) develop appropriate mitigation measures.

Competency Assignment

The head engineer of a proposed coal fired power plant calculates that the facility will continuously release 2.66 x 107 ug/sec of sulfur (SO_2, molecular weight = 64.1 grams per mole) from a stack with an effective stack height of 30 meters.

1. On a day rated to have an atmospheric stability class of “C” with a wind speed of 5 miles per hour, calculate the maximum ground level concentration of sulfur dioxide.
2. If the national ambient air quality standard for sulfur dioxide is 0.14 parts per million (not parts per billion), what would the Air Quality Index be for the scenario described in #1 above?
3. Would this predicted air quality be considered a significant environmental impact?

Mastery Assignment

Using Canter’s textbook chapter on air quality impact assessment, and any additional sources that you find relevant (be sure to provide full citations to any additional sources you use), develop an exam-like question that utilizes a hypothetical proposed project that would release nitrogen dioxide (NO2) at some rate, from an effective stack height other than 30 meters. Your exam-like question should provide a brief project description and a specific NO_2 emission rate. The exam-like question should provide the primary, 1-hour, ambient air quality standard for NO_2 and specify what meteorological conditions are applicable. The question should ask for a predicted maximum concentration of NO2, and ask for the Air Quality Index for those conditions. Do not use the same meteorological data as provided in the Subject Matter 6 Competency assignment. Your exam-like question should be between 75 and 200 words. Additionally, prepare a correct response to your questions that shows the calculations and highlights the answer(s) that could be used by future graders of the question (maximum of 1 page).

1. Calculate the maximum ground level concentration of sulfur dioxide.

Data

Q = 2.66 x 10^7 ug/sec H = 30m μ = 5mph

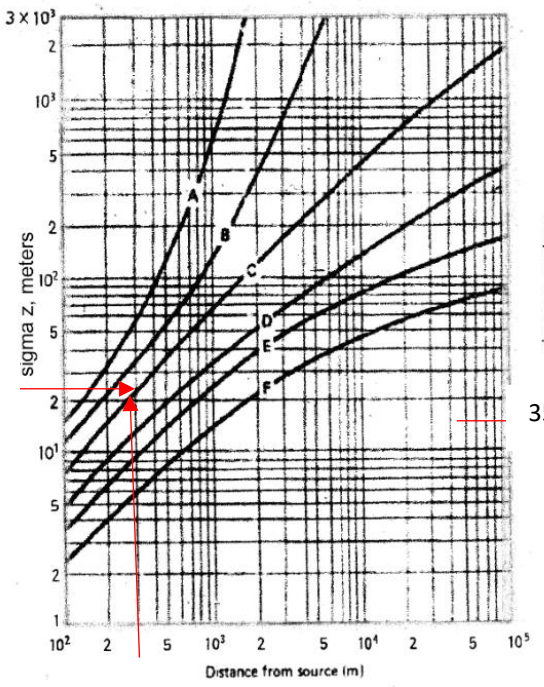
Calculate conversion miles/hour (mph) to meters/second

$$\frac{5\ miles}{hour} = \frac{1610\ meters}{mile} = \frac{1\ hour}{3600\ seconds} = 2.2m/seconds$$

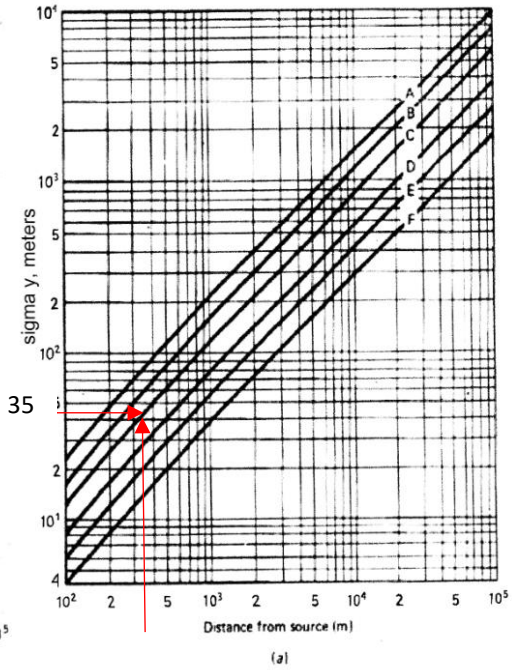
Calculate [Max] where $\sigma_{z=\frac{H}{\sqrt{2}}}$ $\sigma_z = \frac{30m}{\sqrt{2}} = 21.2m$

Use σ_z to find distance with the σ_z plot, and find σ_y with the σ_y plot

21.2



35



300

Data

X = 280m Q = 2.66 x 107 ug/sec σ_z = 21.2m σ_y = 35m H = 30m μ = 2.2m/s

$$c_{x,y,0} = \frac{Q}{\pi(\sigma_z)(\sigma_y)(\mu)} * \ln\left[-\left(\frac{H^2}{2*\sigma_z^2} + \frac{y^2}{2*\sigma_y^2}\right)\right]$$

$$c_{280,0,0} = \frac{2.66*10^7\ ug/sec}{\pi(21.2m)(35m)(2.2m/sec)} * \ln\left[-\left(\frac{30m^2}{2*21.1m^2} + \frac{0^2}{2*35m^2}\right) = 1872\mu g/sec\right]$$

1. Calculate AQI

$$\frac{0.14m^3SO_2}{10^6m^3} = \frac{10^6cm^3}{m^3} = \frac{1mL}{1cm^3} = \frac{1L}{1000mL} = \frac{1mole}{22.4L} = \frac{64.1g}{1mole} = \frac{10^6\mu g}{g} = 401\frac{\mu g}{m^3}$$

$$\frac{condition}{standard} = \frac{1872\mu g/m^3}{402\mu g/m^3} = 4.67\mu g/m^3$$

2. Is the predicted air quality a significant environmental impact?

The predicted air quality is considered a significant environmental impact as the resulting value is 4.67μg/m^3 – indicating the air quality is five times the standard air quality index.

Question

The head of a new powerplant proposed to undergo construction in Michigan's Upper Peninsula calculated the facility to release 5.1 ug/sec of nitrogen dioxide (NO_2, molecular weight = 46 grams per mole) with an effective stack height of 60 meters and a wind speed of 10 miles per hour. Considering the EPA set the primary, 1-hour, ambient air quality standard for NO_2 at 100 parts per billion (ppb), what is the predicted maximum concentration of NO_2 as well as the Air Quality Index for the resulting conditions in an atmospheric stability class of "A."

Answer

Data

Q = 5.1 x 107 ug/sec H = 60m μ = 10mph

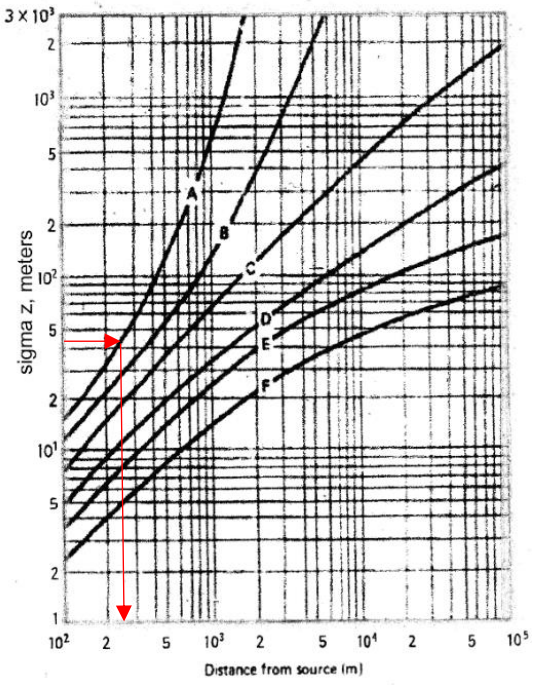
Calculate conversion miles/hour (mph) to meters/second

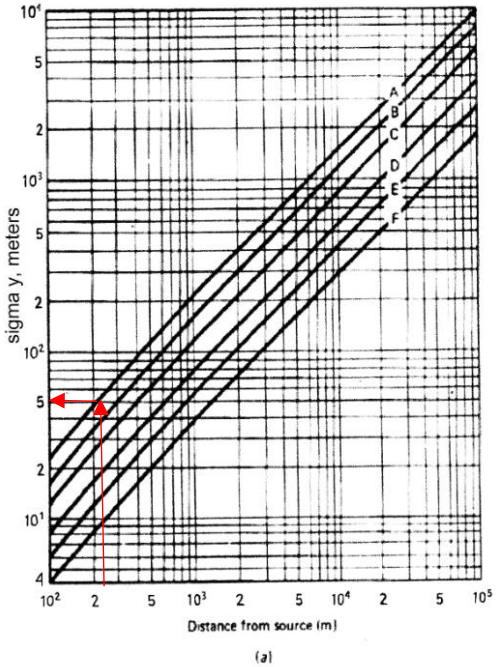
$$\frac{10\ miles}{hour} = \frac{1610\ meters}{mile} = \frac{1\ hour}{3600\ seconds} = 4.47m/seconds$$

Calculate [Max] where $\sigma_{z=\frac{H}{\sqrt{2}}}$

$$\sigma_z = \frac{60m}{\sqrt{2}} = 42.5m$$

Use σ_z to find distance with the σ_z plot, and find σ_y with the σ_y plot





Data

X = 260m Q = 5.1 x 10^7 ug/sec σ_z = 42.5m σ_y = 60m H = 60m μ = 4.47m/s

$$c_{x,y,0} = \frac{Q}{\pi(\sigma_z)(\sigma_y)(\mu)} * \ln\left[-\left(\frac{H^2}{2*\sigma_z^2} + \frac{y^2}{2*\sigma_y^2}\right)\right]$$

$$c_{260,0,0} = \frac{5.1*10^7\ ug/sec}{\pi(42.5m)(60m)(4.47m/s)} * \ln\left[-\left(\frac{60m^2}{2*42.5m^2} + \frac{0^2}{2*60m^2}\right)\right] = 2849.9\mu g/sec$$

Calculate standard conditions

$$\frac{100m^3SO_2}{10^9m^3} = \frac{10^6cm^3}{m^3} = \frac{1mL}{1cm^3} = \frac{1L}{1000mL} = \frac{1mole}{22.4L} = \frac{46g}{1mole} = \frac{10^6\mu g}{g} = 205.4\frac{\mu g}{m^3}$$

$$\frac{condition}{standard} = \frac{2849.9\mu g/m^3}{205.4\mu g/m^3} = \mathbf{13.8\mu g/m^3}$$

Introduction

The objectives for Subject Matter 7 were to diagram the Six Step conceptual model for predicting and assessing the potential noise impacts of a proposed action and the predict the decibel levels of a proposed action.

Noise is referred to as unwanted sound or sound that is in the wrong place at the wrong time. The Environmental Protection Agency defines noise as sound (1) interfering with speech or hearing, (2) high intensity damaging hearing, (3) that is irritating. Sound is defined as vibrating surfaces from mechanical energy (i.e., pressure) which is transmitted by molecules compression and rarefactions passing through gas, liquid, or solid. The six-step conceptual model to a noise impact assessment is to (1) delineate noise emissions, (2) determine the existing noise levels, (3) procure relevant noise criteria or standards, (4) predict noise levels, (5) assess air impacts significance, and (6) identify mitigation measures to incorporate. Use the table to determine cumulative decibel sound pressure levels with known differences between the two:

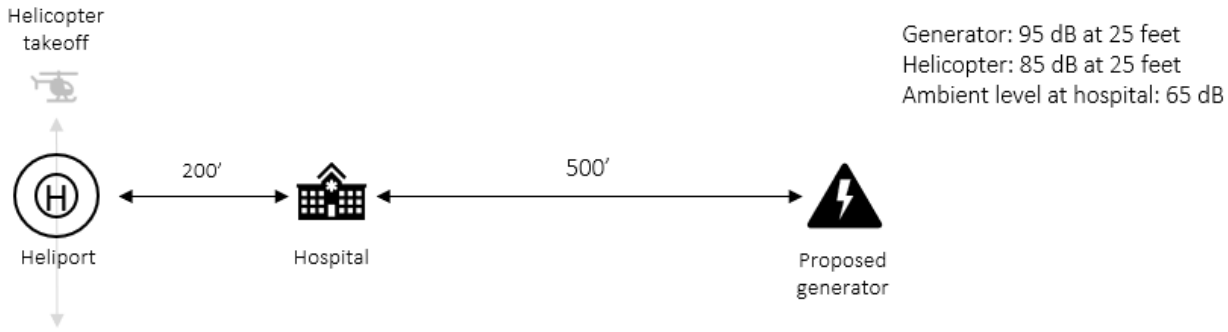
Difference between levels, dB	Number of dB to be added to higher level
0	3.0
1	2.6
2	2.1
3	1.8
4	1.5
5	1.2
6	1.0
7	0.8
8	0.6
10	0.4
12	0.3
14	0.2
16	0.2
>16	0.1

Competency Assignment

An energy company is proposing to build a small diesel-powered electrical generator for emergency purposes that could occur at a small regional hospital. The diesel generator, considered to be a point source of noise, would be located directly east, and 500 feet away from the hospital. Similar diesel stations generate 95 dB at a point 25 feet from the generator. The hospital also operates a heliport for airlifting injured patients to the hospital. Because of the flight path that helicopters use for this hospital, the heliport is considered a line source of noise. The heliport exists 200 feet directly west of the hospital. When helicopters take off or land at the heliport (always in a north/south direction), noise levels up to 85 dB can be measured at a point 25 feet away from the flight path. The existing ambient noise at the hospital is 65 dB where the heliport is not in use. If the diesel generator is approved and constructed, calculate the maximum noise level at the hospital when both the generator and the heliport are utilized simultaneously.

Mastery Assignment

Using Canter's textbook chapter on noise impact assessment, and any additional sources that you find relevant (be sure to provide full citations to any additional sources you use), develop an exam-like question that utilizes a hypothetical proposed project that generate noise and potentially impact a sensitive receptor. Your exam-like question should provide a brief project description and a specific noise characteristic of both the project and the sensitive receptor. The question should ask for a predicted maximum noise level if both the proposed action is completed considering any other nearby noise sources and/or ambient noise levels. Do not use the same scenario provided in the Subject Matter 7 Competency assignment. Your exam-like question should be between 75 and 200 words. Additionally, prepare a correct response to your questions that shows the calculations and highlights the answer(s) that could be used by future graders of the question (maximum of 1 page).



Point Source

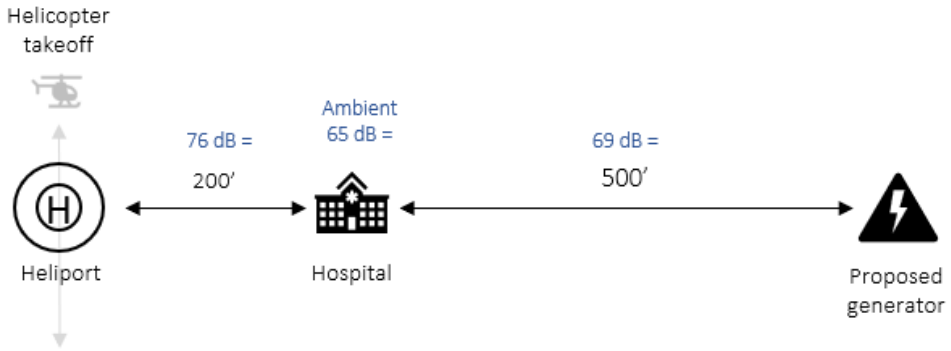
$$SL_2 = SL_1 - 20log_{10}(\frac{r_2}{r_1})$$

$$SL_2 = 95dB - 20log_{10}(\frac{500}{25}) = 69dB$$

Line Source

$$SL_2 = SL_1 - 10log_{10}(\frac{r_2}{r_1})$$

$$SL_2 = 85dB - 10log_{10}(\frac{200}{25}) = 76dB$$



Determining cumulative decibel sound pressure levels with known differences between the two:

Difference between the two loudest levels =

76 dB – 69 dB = 7 dB

Add 0.8 dB to higher level =

76 + 0.8 = 76.8 dB

Difference between levels =

76.8 dB – 65 dB = 11.8

Add 0.3 dB to higher level = 77.1

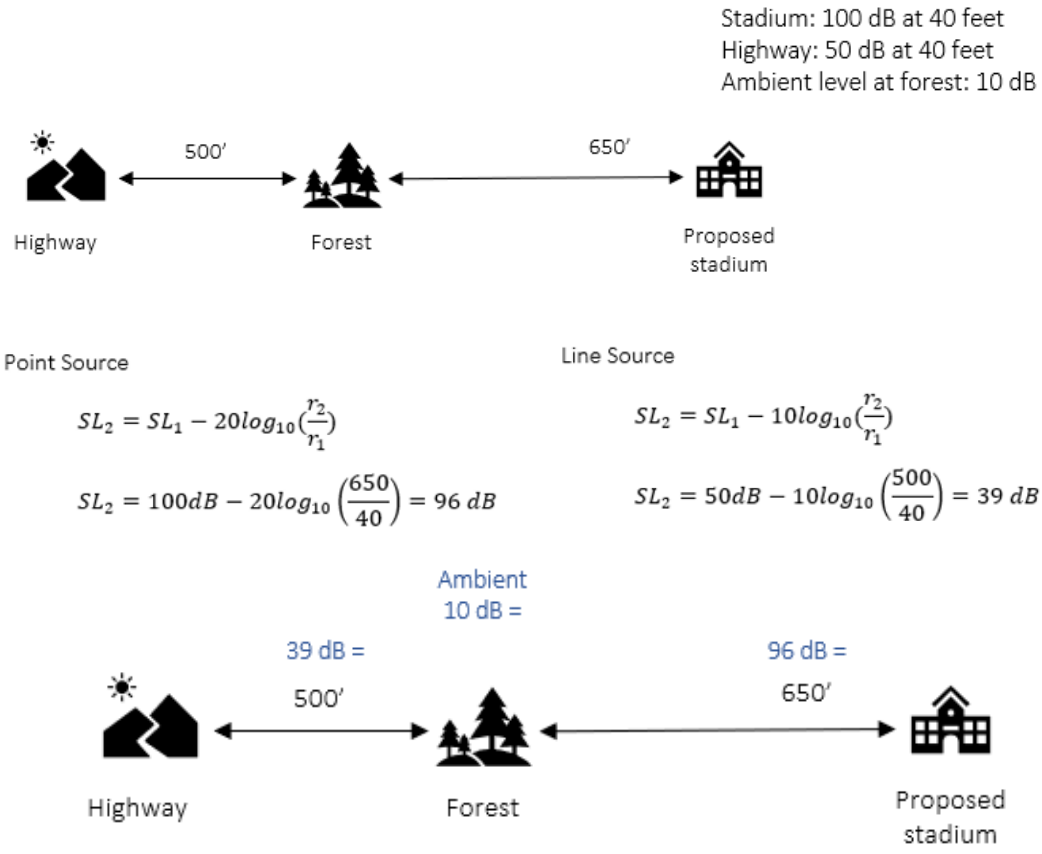
Maximum noise level at hospital when the generator and heliport are utilized simultaneously =

76 dB + 0.8 dB + .3 dB = **77.1 dB**

Question

A development company is proposing to build a stadium in Northern Michigan, a point source of noise, for a site 650 feet directly east of a forest patch. Similar stadiums generate 100 dB at a point 40 feet from the source. The forest patch also has a highway directly to the west of the forest patch located 500 feet away. The highway generates noise levels up to 50 dB at a point 40 feet from the source. The existing ambient noise at the patch of forest is 10 dB during the night, when the highway isn't being driven on. Always start with a drawing and calculate the maximum noise level at the forest patch if the stadium is approved.

Answer



Difference between levels =

96 dB – 63 dB = 57 dB

Maximum noise level at hospital when the generator and heliport are utilized simultaneously =

96 dB + 0.1 = **96.01 d**

Introduction

The objectives for Subject Matter 8 were to recognize the Six-Step conceptual model for predicting and assessing potential habitat impacts of a proposed action and predict the level of habitat impacts under given project characteristics and specific conditions of the habitat.

Explore the approaches and technical applications of assessing the impact on habitats from a proposed action. Continue the Six-Step conceptual model for obtaining relevant information regarding the proposed project and reasonable alternatives, predicting a proposed action's impacts to habitats should it be implemented, assessing significance of the impact, and mitigation measures to offset the resultant impacts from a proposed action.

Competency Assignment

A floating casino has been proposed for an area along the Gulf Coast of Costa Rica. The Costa Rican Marine Fisheries Service (CRMFS) suggested brown shrimp would be a good indicator species for estimating the impact of the proposed action on the local estuary. CRMFS projected the brown shrimp habitat quality in the estuary will remain constant over the next 25 years if the casino is not built. The project proponent projects the following conditions if the casino is built (table values are Suitability Index scores for each variable at each time frame):

Model Component	Current Conditions, Before Floating Casino Project	Future Conditions with Floating Casino in 5 years	Future Conditions with Floating Casino in 10 years	Future Conditions with Floating Casino in 25 years
V1: % estuary covered by vegetation	1.0	0.5	0.2	0.1
V2: substrate composition	1.0	0.2	1.0	0.8
V3: average spring salinity, ppt	0.8	1.0	1.0	0.8
V4: average spring temp., ^{o}C	1.0	1.0	1.0	1.0

Two life requisites for the brown shrimp: Food Cover: $(SI_{V1}^2 \times SI_{V2})^{1/3}$ and Water Quality: $(SI_{V3} \times SI_{V4})^{1/2}$

We can assume that:

1. The future quality of the estuary without the casino stays identical to current conditions
2. If the casino were to be built, a total of 4 hectares would be impacted
3. There is a nearby estuary where mitigation efforts can be applied
4. The mitigation estuary can be managed such that quality is improved from 0.6 to 0.8 HIS

How many brown shrimp habitat units (average annualized) will there be if the casino project does not go forward? How many habitat units (average annualized) will there be if the casino project does go forward? How many habitat units (average annualized) will be lost if the casino project goes forward? How much mitigation area would be required to offset the impact of the casino on the brown shrimp?

Mastery Assignment

Using the U.S. Fish and Wildlife Service's Habitat Suitability Index model for the Fox Squirrel (*Sciurus niger*), the largest North American tree squirrel, develop an exam-like question utilizing a hypothetical proposed project potentially impacting the habitat of a local population. Present a hypothetical scenario with a brief project description and data specific to the habitat for year 0 current conditions, year 5 future, year 10 future, and year 25 future. Ask for:

1. Annualized Fox Squirrel habitat units for the future without the project
2. Annualized Fox Squirrel habitat units for the future with the project

3. Impact of the proposed action on Fox Squirrel habitat
4. How much mitigation land would be required to offset the impact

Calculation	Equation	Current Conditions, Before Floating Casino Project	Future Conditions with Floating Casino 5 years in the future	Future Conditions with Floating Casino 10 years in the Future	Future Conditions with Floating Casino 25 years in the Future
Food Cover	$(SI_{V1}^2 \times SI_{V2})^{1/3}$	1	0.36	0.34	0.43
Water Quality	$(SI_{V3} \times SI_{V4})^{1/2}$	0.9	1	1	0.89
Habitat Units (HU)	(Lowest HSI * Acres)	3.58	1.47	1.36	0.80

Brown shrimp HUs (average annualized) if the casino project does not go forward:

If the floating casino project does not move forward, there will be 3.58 brown shrimp habitat units. Calculated by: 0.89 HU * 4 ha * 25 years = 89.5 HUs total / 25 years = 3.58 average annualized HU.

HUs (average annualized) if the casino project does go forward:

If the floating casino project does move forward, there will be 1.47 brown shrimp habitat units after five years. Calculated by: ((3.58 + 1.48) / 2) *5 + ((1.48 + 1.36) / 2) *5 +((1.36 + 0.80) / 2*15 = 35. 94 HU / 25 years = 1.47 average annualized HU.

HUs (average annualized) lost if the casino project goes forward:

If the casino project moves forward, there will be 2.14 average annualized habitat units lost. Calculated by: 3.56 without – 1.44 with = 2.12 average annualized HU lost.

Mitigation area required to offset the impact of the casino on the brown shrimp:

It would take 10.7 ha of mitigation area required to offset the impact of the casino on brown shrimp habitat. Mitigation area required to offset the impact was determined dividing both the HU without (i.e., current conditions) and HU with (i.e., future conditions) by the HSI change if the mitigation estuary nearby is managed such that quality is improved from 0.6 to 0.8 (i.e., 0.2). Specifically, (3.6/0.2 – 1.4/0.2) = ~10.7 ha required of mitigation area.

Question

A new housing development was proposed for an area near Lake Michigan. The Department of Natural Resources (DNR) suggested the fox squirrel as an indicator species to estimate the impact(s) of the project on the local forest. The DNR projected fox squirrel habitat quality in the forest to remain constant over 25 years if the housing development does not move forward. The project proponent projects the following current conditions prior to the development and future conditions if the neighborhood is built:

Variable	Definition	Current Conditions	Future Conditions 5 years	Future Conditions 10 years	Future Conditions 25 years
V_1	% hard mast canopy closure	0.7	0.3	0.3	0.4
V_2	Distance to grain	0.7	0.2	0.2	0.3
V_3	Average dbh overstory	0.6	0.2	0.3	0.4
V_4	% tree canopy closure	1.0	0.2	0.2	0.2
V_5	% shrub crown cover	0.8	0.3	0.5	0.7

Two life requisites important for the fox squirrel:

$$\text{Winter Food} = ((3V_1 + V_2) / 3) \qquad \text{Cover} = (V_3 \times V_4 \times V_5)^{1/3}$$

Assuming:

1. Future quality of the forest without the development is identical to current conditions
2. If the neighborhood were to be built, a total of 30 hectares would be impacted
3. There is a nearby forest where mitigation efforts can be applied
4. The mitigation forest can be managed such that quality is improved from 0.2 to 0.5 HIS

Calculate annualized fox squirrel habitat units (HU) (1) without the development, (2) with the development, (3) lost if the development moves forward, and (4) the mitigation land area required to offset the impact of the project. State what the results indicate.

Answer

If the housing development project was not to move forward, there would be 23.49 annualized fox squirrel habitat units. In contrast, if the project were to move forward, there would be 6.87 HU after 5 years, 9.32 after 10 years, and 11.48 HU after 25 years. Moreover, 16.62 HU would be lost of fox squirrel habitat after 5 years, 14.17 HU lost after 10 years, and 12.01 HU lost after 25 years. These results indicate that the forest will start to recover more each increment of year following deforestation for the housing development.

If mitigation measures are taken to manage the forest, improving the quality from 0.2 to 0.5 (i.e., 0.3), the area required to offset the impact of the project over the years decreases from 55.40 ha after 5 years, 47.23 after 10 years, and 38.26 after 25 years. As such, the results further indicate that the forest will start to recover more each increment of year proposed.

Calculation	Equation	Current Conditions	Future 5 years	Future 10 years	Future 25 years
Winter Food	$((3V_1 + V_2)/3)$	0.93	0.37	0.37	0.50
Cover	$(V_3 \times V_4 \times V_5)^{1/3}$	0.78	0.23	0.31	0.38
Habitat Units	(Lowest HIS * Acres)	23.49	6.87	9.32	11.48
HU Lost	(HU without - HU with)	23.49	16.62	14.17	12.01
Mitigation Area	(HU without/0.3 - HU with/0.3)		55.40	47.23	38.26

Introduction

Objectives for subject matter 9 were to describe the 8 principles of considering future environmental conditions, the 11 steps needed to complete a future with and without proposed action, and synthesize the principles and steps relationship to the 5 requirements NEPA mandates for EIS content.

Looking at the future with a proposed action and the future without a proposed action recognizes there are cumulative effects that can result from an action moving forward. Cumulative effects account for environmental impacts resulting from direct and indirect effects (i.e., incremental) of an action in addition to the past, present, and future actions that are reasonably foreseeable. Reasonably foreseeable future actions are predicted actions relative to current conditions or expected needs.

Competency Assignment

Prepare a short essay (500 to 1000 words) that expresses your thoughts on the links between the 5 items that the National Environmental Policy Act requires to be included in an Environmental Impact Statement (see Section 102.C of NEPA) and the 8 Principles of and the 11 Steps for Considering Future Environmental Conditions (see Subject Matter 9 video and Power Point Handout). Additionally, Review Assignment #1 - A lawsuit challenging an environmental assessment, is available and due in a couple of weeks, and reading that lawsuit may help inform your response here.

Mastery Assignment

Using NEPA's five topics that are required in an EIS, CEQ's regulations on the format of an EIS, Canter's textbook chapter on planning an assessment, and any additional sources that you find relevant (be sure to provide full citations to any additional sources you use), develop an exam-like short-answer essay question that asks an insightful question related to considering future environmental conditions with and without a proposed action (100 to 200 words). Prepare a typical short-answer essay response (100 to 200 words) that could be used as a guideline for future graders of the question.

As the National Environmental Policy Act of 1969 (NEPA) requires the (1) environmental impact of a proposed action, (2) unavoidable adverse environmental impacts, (3) alternatives considered, (4) relationship between short-term use of man's environment and maintaining and enhancing long-term productivity, and (5) irreversible or irretrievable resource commitments potentially involved in an Environmental Impact Statement (EIS), it is critical to consider future environmental conditions if the action proposed is implemented. Specifically, the addition of impacts resulting from direct and indirect effects (i.e., incremental) of an action to a previous, current, and/or reasonably foreseeable future action. In other words, considering future environmental conditions when developing an EIS and the impacts of a proposed action prevents division of projects into several projects with insignificant impacts accumulating as significant impacts.

The eight principles when considering future environmental conditions are (1) comprised of past, present, and foreseeable future actions within reason, (2) estimates represent overall conditions, direct and direct effects of current actions as well as future, (3) specific resources analyzed, (4) focused on meaningful actions, (5) rarely aligned with political or administrative boundaries, (6) similar effects accumulated or varying effects interacting, (7) possible to last for many years following action, and (8) impacts that can be accommodated in time and space. When addressing NEPA's (1) the environmental impacts of a proposed action, it is important to consider future conditions as they are a function of current and past conditions which influence specific environmental resources directly and indirectly. Resultantly, there can be other things that impact future conditions of environmental resources other than the action proposed which is also important when addressing (2) any unavoidable adverse environmental impacts and (5) irreversible or irretrievable commitments of resources. Considering it isn't feasible to predict all future conditions, focusing on truly meaningful resources/impacts is important when considering future conditions to avoid focusing on resources or impacts that are not significant to ensure long-term productivity. Moreover, considering future conditions of resources as they are rarely aligned with administrative or political boundaries prevents can prevent detrimental impacts from accumulating throughout water resources for example, resulting in an irreversible commitment of those resources. Including similar effects that could accumulate or different effects interacting, further prevents (5) irreversible commitments of resources while (4) maintaining long-term productivity of man's environment short-term. Overall, considering future conditions prevents the possibility of effects lasting many years when analyzing the capacity to accommodate for additional effects.

The 11 steps needed to complete the consideration of future conditions with and without a proposed action moving forward are comprised of four impact assessments from Subject Matter 9 Competency – Future with and without Action being scoping, describing the affected environment, determining environmental conditions, and determining significance. Specifically, scoping relates to NEPA's (1) environmental impact of a proposed action, (2) adverse environmental effects, (4) long-term productivity of resources in man's short-term environment, and (5) irreversible resource commitments as scoping is comprised of (1) identifying of truly meaningful direct and indirect effects and environmental resources impacted, (2) establishment of a resources geographic scope, (3) establishment of a time frame for analysis of resources, and (4) identification of other truly meaningful current and future actions impacting the resources of concern. Addressing and identifying significant issues is important when considering future conditions as it determines those analyzed in depth through the EIS process. As such, it ensures focusing on those most truly meaningful. Describing the affected environment characterizing the identified (5) resources response to changes and ability to withstand impacts and (6) resources related to regulated thresholds relates to all five of NEPA's required items and is important when considering future conditions as it thoroughly analyzes the long-term viability of a resource preventing irreversible impacts

while accounting for unavoidable adverse effects. When determining environmental consequences, considering the magnitude of future effects on resources (7) without and (8) with a proposed action moving forward specifically considers NEPA's (5) irretrievable or irreversible commitment of a resource and is important as it prevents a future situation at which a natural environment or resource cannot be maintained from. Determining significance of future conditions as those (9) without the action, (10) with the action, and (11) differences with and without when addressing NEPA's required items is critical as the majority of assessments don't prioritize future conditions and the resultant differences between those with and without has the potential to initiate an EIS.

Question

Principle five of the eight principles that consider future environmental conditions with and without the implementation of an action proposed considers future environmental conditions of a specific resource which rarely aligns with administrative or political boundaries. Why is this an important consideration of future environmental conditions of a proposed action moving forward?

Answer

It is important to understand that environmental resources rarely align with administrative or political boundaries as the environmental data collected is frequently based on political boundaries within counties but in the natural world, environmental resources are not typically distributed similarly to political or administrative boundaries put forth by human activities. As such, restricting environmental resources to arbitrary human boundaries restricts the reality of the future conditions of a given resource resulting in inefficient analyses. For example, water resources that flow through cities, counties, or over neighboring state boundaries don't reflect arbitrary boundary lines that human activities have constructed for administrative or political purposes. Or, air quality may vary as air being an invisible gas comprised of varying components, circulates the entirety of Earth's atmosphere resulting from wind. Thus, when establishing those future conditions with and without the proposed action moving forward, environmental resources should not be restricted to assessing conditions at boundaries as the arbitrary boundaries does not reflect the natural occurrence of given resources.

Introduction

The objectives for subject matter 10 were to describe two techniques selecting a preferred alternative using decision factors and importance weighting of those factors and apply the paired comparison to select the preferred alternative.

Selecting the preferred alternative acknowledges the alternative actions that are proposed for a project with varying results from the impact of the particular action as it proposed. Selecting the alternative action is based on qualitative, quantitative, ranking, weighting, or weighted ranking. Techniques to select the preferred alternative use rank order scoring or a paired comparison technique when given a list of decision factors to consider.

Competency Assignment

Using the paired comparison techniques, prepare a set of tables, with completed analyses, and identify the preferred alternative using the following data:

		Alternative		
Factor	Importance	A	B	C
Cost of mitigation	High	$175K	$200K	$35K
Tons of air pollution	High	41.9	49.1	45.5
Aesthetic impacts	Low	Little	Moderate	Moderate
Increase in job #'s	Moderate	1,000	900	1,100
Public support of alternative	Moderate	Moderate	Some	None

Alternative Scoring (2: substantially better; 1: somewhat better; 0.5: equal; 0: worst)

Mastery Assignment

Using Canter's textbook chapter on selecting a preferred alternative, and any additional sources, develop an exam-like problem that utilizes at least 4 alternatives and at least 5 decision factors. Provide hypothetical data for each decision factor for each alternative, and information on differential importance weights for each decision factor. The problem should require an identification of the preferred alternative using the paired comparison approach and all details of the analysis must be shown. Your exam-like problem should include no more than 50 words to set up the problem, and include one and only one table showing the decision factors and hypothetical data for each decision factor for each alternative. Additionally, prepare a correct response to your questions that shows the calculations and highlights the answer that could be used by future graders of the question.

	Alternative	A → B	A → C	B → C	A → Dummy	B → Dummy	C → Dummy	Total Points	
Mitigation Cost	A	1	0		1			2	8
	B	0		0		1		1	
	C		2	2			1	5	
	Dummy				0	0	0	0	
Air Pollution	A	1	1		1			3	6
	B	0		0		1		1	
	C		0	1			1	2	
	Dummy				0	0	0	0	
Aesthetics	A	0	0		1			1	6
	B	1		0.5		1		2.5	
	C		1	0.5			1	2.5	
	Dummy				0	0	0	0	
Jobs	A	1	0		1			2	6
	B	0		0		1		1	
	C		1	1			1	3	
	Dummy				0	0	0	0	
Public Support	A	1	2		1			4	8
	B	0		1		1		2	
	C		1	0			1	2	
	Dummy				0	0	0	0	

	Alternative Scores		
Factor	**A**	**B**	**C**
Mitigation Cost	2	1	5
Air Pollution	3	1	2
Aesthetics	1	2.5	2.5
Jobs	2	1	3
Public Support	4	2	2
SUM	12	7.5	14.5

Decision Factor Importance Weighting (1: most important; 0.5: equal; 0: worst)

Factor	Cost	Pollution	Aesthetic	Jobs	Support	Dummy	Total Points
Cost		0.5	1	1	1	1	4.5
Pollution	0.5		1	1	1	1	4.5
Aesthetic	0	0		0	0	1	1
Jobs	0	0	1		0.5	1	2.5
Support	0	0	1	0.5		1	2.5
Dummy	0	0	0	0	0	0	0

Alternative Score Development

		Alternative Scores * Importance Weight					
Factor	Weight	A		B		C	
Mitigation Cost	4.5	2	9	1	4.5	5	22.5
Air Pollution	4.5	3	13.5	1	4.5	2	9
Aesthetics	1	1	1	2.5	2.5	2.5	2.5
Job Increase	2.5	2	5	1	2.5	3	7.5
Public Support	2.5	4	10	2	5	2	5
SUM			38.5		19		46.5

The paired comparison techniques identified Alternative C as the preferred alternative, an expected result as Alternative C had the lowest value for cost of mitigation as well as tons of air pollution in comparison the Alternative A and B. Those of which hold the highest importance weight of the decision factors.

Question

There are four alternatives to the proposed wildlife corridor to be built over U.S. 127 connecting Roscommon State Forest area in Michigan. Using the paired comparison approach, identify the most preferred alternative with the following data:

			Alternative			
Factor	Importance	Weight	A	B	C	D
Noise Pollution (dB)	Moderate	3	100	100	105	125
Air Pollution (tons)	Low	1.5	45	45	40	45
Habitat (ha)	High	4.5	70	75	80	75
Jobs (#)	High	4.5	50	50	75	150
Mitigation Costs ($)	Low	1.5	75,000	100,000	150,000	200,000

Alternative Scoring

2: substantially better; 1: somewhat better; 0.5: equal; 0: worst

Decision Factor Importance Weighting

1: most important; 0.5: equal; 0: worst

Answer

The resultant paired comparison approach identified Alternative D as the most preferred alternative approach to the proposed wildlife corridor.

	Alternative	A → B	A → C	A → D	B → C	B → D	C → D	Dummy	Total Points
Noise Pollution (dB)	A	1	1	2				1	5
	B	0			1	1		1	3
	C		0		0		1	1	2
	D			0		0	0	1	1
	Dummy	0	0	0	0	0	0		11
Air Pollution (tons)	A	1	0	0				1	2
	B	0			0	0		1	1
	C		1		1		1	1	4
	D			1		1	0	1	3
	Dummy	0	0	0	0	0	0		10
Habitat (ha)	A	1	0	0				1	2
	B	0			0	0		1	1
	C		1		1		1	1	4
	D			1		1	0	1	3
	Dummy	0	0	0	0	0	0		10
Jobs (#)	A	0.5	0	2				1	3.5
	B	0.5			0	0		1	1.5
	C		1		1		0	1	3
	D			0		2	2	1	5
	Dummy	0	0	0	0	0	0		13
Mitigation Costs ($)	A	0	0	0				1	1
	B	1			0	0		1	2
	C		2		1		0	1	4
	D			2		2	1	1	6
	Dummy	0	0	0	0	0	0		13

	Alternative Scores			
Factor	A	B	C	D
Noise Pollution (dB)	5	3	2	1
Air Pollution (tons)	2	1	4	3
Habitat (ha)	2	1	4	3
Jobs (#)	3.5	1.5	3	5
Mitigation Costs ($)	1	2	4	6
SUM	13.5	8.5	17	18

		Alternative Scores * Importance Weight							
Factor	Weight	A		B		C		D	
Noise Pollution (dB)	3	5	15	3	9	2	6	1	3
Air Pollution (tons)	1.5	2	3	1	1.5	4	6	3	4.5
Habitat (ha)	4.5	2	9	1	4.5	4	18	3	13.5
Jobs (#)	4.5	3.5	15.75	1.5	6.75	3	13.5	5	22.5
Mitigation Costs ($)	1.5	1	1.5	2	3	4	6	6	9
SUM			44.25		24.75		49.5		52.5

Review a case study to identify and discuss several key issues contained within the findings of a court case involving three Corps permit actions for floating casinos on the Mississippi Gulf Coast. The findings concern direct, indirect, and cumulative (future with and without casino) effects.

Record the page numbers from the document and answer each question (25 to 50 words):

Page	Question	Answer
3	What comments on the Public Notice of the Casino World application were received by the Corps from EPA, FWS, NMFS, and MDMR? Are the comments *similar* for the other two casino permits? *Mississippi Department of Wildlife, Fisheries and Parks (MDWFP)	*EIS - Direct, indirect, & cumulative* Casino World – All agencies suggested *EIS*: • *Water & habitat quality* • Upland development • Several casino developments Circus Circus – All requested *EIS*: • *Water quality*, aquatic life, tidal/waterbottoms, wetlands, marshes, upland forests, habitat loss Royal D'Iberville – FWS, NMFS, MDWFP opposed permit without *EIS*: • *Water & habitat quality*
4	How did this court define "arbitrary and capricious"?	An agency action if the agency: (1) Failed to assess a feature of the problem of interest, (2) Justified a decision despite contradicting evidence, or (3) Is unlikely attributed to a contrasting view, or (4) Is unlikely the result of an agency's proficiency
4	What 4-step analysis was used to determine if an EA – FONSI was appropriate for the three casinos?	The agency must have: (1) Accurately recognized the appropriate environmental problem, (2) Thoroughly analyzed the identified problem in the EA, (3) Reassuring evidence for a finding of no significant impact, (4) Discovered adequate modifications or protective measures minimizing impacts from finding a true significant impact - to avoid an EIS

a. 5, 6 b. 5 c. 6 d. 6 e. 6, 7 f. 7 g. 7	How did the Court rule regarding the Corps' treatment of the following direct impacts in the three EAs? a. Dredging b. Water Quality c. Wetlands d. Aquatic Habitat e. Intake of Larvae & Eggs f. Aquifers g. Scouring or Shoaling	a. Dredging • Ruled for Casino World • Ruled against Circus Circus and Royal D'Iberville b. Water Quality • Ruled for c. Wetlands • Ruled against d. Aquatic Habitat • Ruled against e. Larvae and Egg Intake • Ruled against Circus Circus f. Aquifers • Ruled for Royal D'Iberville g. Scouring/Shoaling • Ruled for Royal D'Iberville
9	What did the court say about cumulative effects?	Despite ~9-10 pages dedicated to cumulative effects, there was no analysis to support each EAs conclusion that cumulative direct impacts were minimal. The court cannot review the agency's finding of no significant impact without any analyses.
9, 11, 12	What two out of CEQ's ten significance criteria were singled out by Judge Friedman to indicate that an EIS was required?	(3) Impacts unique characteristics - ecologically critical areas / wetlands • St. Louis Bay - large undisturbed marsh • Expert opinions regard ecological significance (4) Degree of impact on environmental quality - highly controversial • 3 federal, 1 state, and public – disputed evaluations • Permit controversy - concerning the EPA and Department of Interior
	What is the primary lesson you learned from the review of this court decision?	Thorough and honest assessments are important. A project can move forward with a finding of no significant impact and an EIS to be unnecessary, despite inadequate analyses assessing environments. Although one direct impact may not be significant it can be a significant cumulative impact (e.g., dredging and aquatic habitat).

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Atkinson's Power Point Handout on Subject Matter 1.

Atkinson's Power Point Handout on Subject Matter 2.

Atkinson's Power Point Handout on Subject Matter 3.

Atkinson's Power Point Handout on Subject Matter 4.

Atkinson's Power Point Handout on Subject Matter 5.

Atkinson's Power Point Handout on Subject Matter 6.

Atkinson's Power Point Handout on Subject Matter 7.

Atkinson's Power Point Handout on Subject Matter 8.

Atkinson's Power Point Handout on Subject Matter 9.

Atkinson's Power Point Handout on Subject Matter 10.

Atkinson's Video Workshop Data Sheet.

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