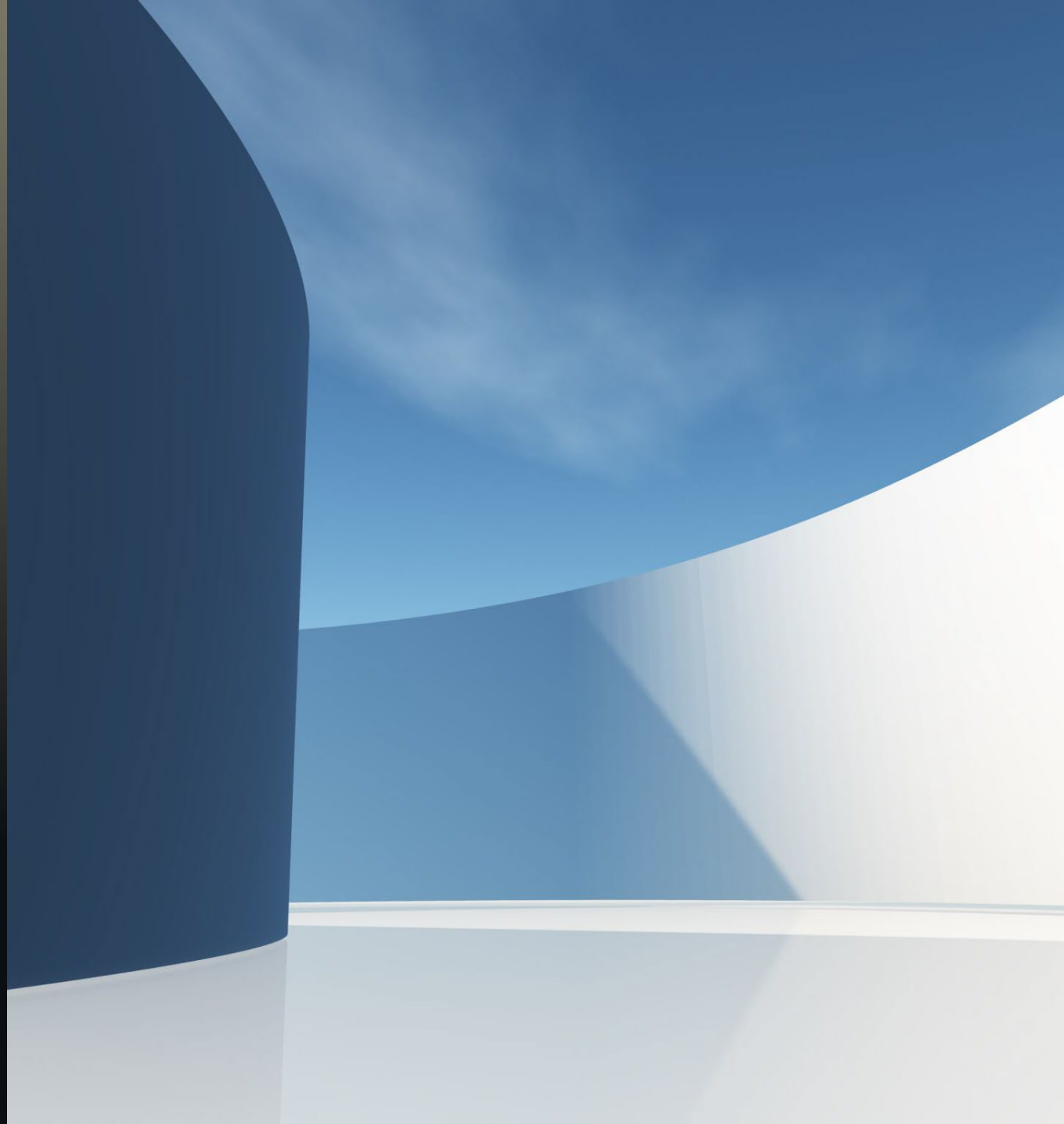


Oregon EJ Mapping Tool Decision Points

BACKGROUND INFORMATION



Decision Points: Why are they important?

Composite indices are complex and there are many options for the EJ Council to choose from that will determine how the Oregon EJ Mapping Tool is structured and how the information is displayed.



HB 4077, sections 10-12 include language that will help guide the EJ Council through the decision-making process, but the content leaves a lot of room for flexibility.



All environmental justice mapping tools get evaluated, critiqued, and scrutinized. Therefore, it is important to have a rationale that supports each decision made in the development of the Oregon EJ Mapping Tool.

DECISION POINTS 1-10

#1

- Indicator domain selection

#2

- Geographic units (tracts, grids, etc.)

#3

- Geographic designations
- Geographic comparisons

#4

- Domain/indicator weighting

#5

- Domain aggregation (multiplicative, additive, etc.)

#6

- Data standardization (percentiles, z-scores, other)

#7

- Indicator selection - community listening session priorities and data gaps

#8

- Sensitivity analysis results - revisit indicator selection and data gaps

#9

- EJ community thresholds/flags

#10

- EJ mapping tool visualizations & reporting

Domain Selection

ENVIRONMENTAL JUSTICE MAPPING
DECISION POINT 1

[APRIL 11, 2024 RECORDING LINK](#)

DECISION POINT #1: INDICATOR DOMAIN SELECTION

Why use indicator domains?

- Establish criteria for selecting indicators
- Control indicator weighting
- Flag content areas driving the index score



CalEnviroScreen/ Washington EHD Map/ MiEJScreen
Pollution Burden • Environmental Exposures • Environmental Effects
Population Characteristics • Sensitive Populations • Socioeconomic Factors

Colorado EnviroScreen
Pollution Burden • Environmental Exposures • Environmental Effects • Climate Vulnerability
Population Characteristics • Sensitive Populations • Socioeconomic Factors

DECISION POINT #1: INDICATOR DOMAIN SELECTION

APRIL 11, 2024

DECISION POINT #1: INDICATOR DOMAIN SELECTION

HB 4077, Section 10:

1. XXXX
2. “Environmental burden” means the environmental and health risks to communities caused by the combined historic, current and projected future effects of
 - a. Exposure to conventional pollution and toxic hazards in the air or in or on water or land;
 - b. Adverse environmental conditions caused or made worse by other contamination or pollution; and
 - c. Changes in the environment resulting from climate change, such as water insecurity, drought, flooding, wildfire, smoke and other air pollution, extreme heat, loss of traditional cultural resources or foods, ocean acidification and increases in infectious disease.
3. “Environmental justice” means the equal protection from environmental and health risks, fair treatment and meaningful involvement in decision making of all people regardless of race, color, national origin, immigration status, income or other identities with respect to the development, implementation and enforcement of environmental laws, regulations and policies that affect the environment in which people live, work, learn and practice spirituality and culture.
4. “Environmental justice community” includes communities of color, communities experiencing lower incomes, communities experiencing health inequities, tribal communities, rural communities, coastal communities, communities with limited infrastructure and other communities traditionally underrepresented in public processes and adversely harmed by environmental and health hazards, including seniors, youth and persons with disabilities.

DECISION POINT #1: INDICATOR DOMAIN SELECTION

The Environmental Justice Mapping Tool Methodology Workgroup recommends the following indicator domains and subdomains:

Oregon Environmental Justice Mapping Tool	
Place (Community Burdens & Benefits) • Environmental Exposures • Environmental Effects • Climate Change Risks • Built Environment	People (Vulnerable Populations & Opportunities) • Human Health Disparities • Demographic and Social Factors

Methodology Rationale:

The domains are intentionally broad, and the structure is easy for users to follow.

Environmental exposures, toxic hazards, climate change risks, human health, demographics and social factors, and community benefits are directly mentioned HB 4077.

DECISION POINT #1: INDICATOR DOMAIN SELECTION

The built environment is indirectly mentioned in HB 4077 in the definition of EJ communities as “communities with limited infrastructure.”

Oregon natural resources agencies whose primary focus is the built environment will be better equipped to contribute to and use the EJ Mapping Tool with the inclusion of a built environment subdomain.

Federal grants from the Inflation Reduction Act and Bipartisan Infrastructure Law prioritize built environment investments that advance environmental justice in communities, improve health and equity, and reduce greenhouse gas emissions.

ADOPTED DECISION POINT 1

Oregon Environmental Justice Mapping Tool

Place (Community Burdens & Benefits)

- Environmental Exposures
- Environmental Effects
- Climate Change Risks
- Built Environment

People (Vulnerable Populations & Opportunities)

- Human Health Disparities
- Demographic and Social Factors

Geographic Units

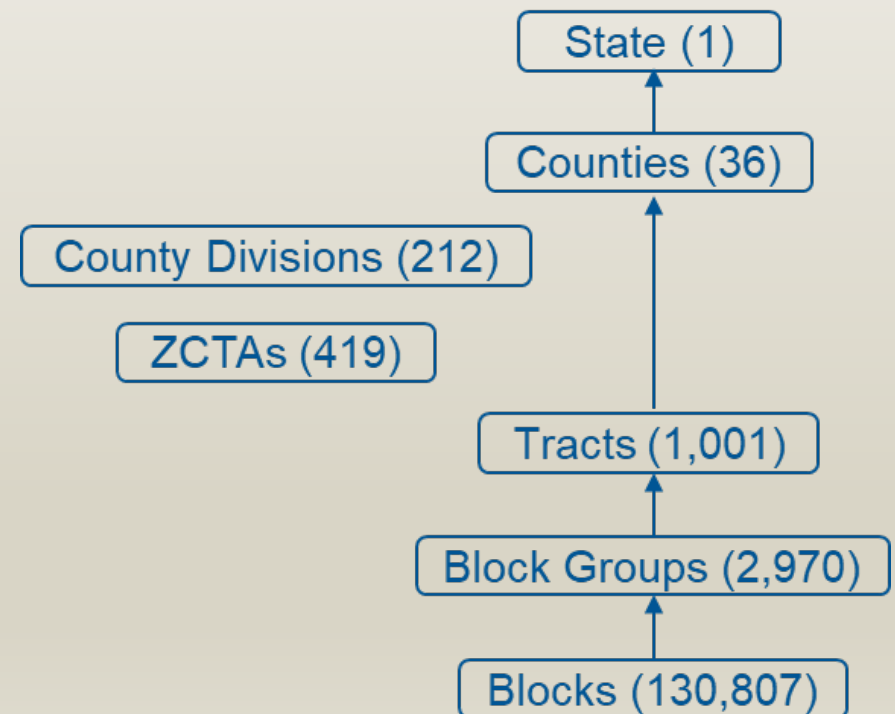
ENVIRONMENTAL JUSTICE MAPPING
DECISION POINT 2

[APRIL 11, 2024 RECORDING LINK](#)

DECISION POINT #2: GEOGRAPHIC UNITS

What are geographic units?

- Geographic units are the spatial boundaries that will be used to define Oregon communities.
- Examples of geographic units include:
 - Census block groups
 - Census tracts
 - Census county divisions
 - Census zip code tabulation areas
 - Neighborhood boundaries
 - Uniform grids
 - Hybrid of geographic units



Why are geographic units important?

DECISION POINT #2: GEOGRAPHIC UNITS

Data reliability, privacy, and security concerns

- The size of geographic units affect the reliability of data and whether data can be displayed due to privacy and security rules.

Data aggregation concerns

- Some data will need to be aggregated by natural resources agencies to fit the geographic units that are selected.

Availability concerns

- Some data are not available for smaller geographic units, like block groups, and may not be adaptable to fit within those units.

DECISION POINT #2: GEOGRAPHIC UNITS

Methodology Workgroup Recommendation:

The Environmental Justice Mapping Tool Methodology Workgroup recommends **Census tracts** for the primary geographic unit defining community boundaries in the first version of the Oregon EJ Mapping Tool.

The Methodology Workgroup also recommends the inclusion of additional geographic units in the EJ Mapping Tool including Census county divisions, zip codes, and county boundaries in the second version of the mapping tool.

DECISION POINT #2: GEOGRAPHIC UNITS

Methodology
Rationale

Census tracts are the smallest geographic unit that many American Community Survey data are available at with a reasonable degree of reliability.

Census tracts are used as the primary layer in most state and federal EJ mapping tools and are the standard for many community-based mapping tools.

DECISION POINT #2: GEOGRAPHIC UNITS

Methodology Workgroup note to the EJ Council:

“The Methodology Workgroup acknowledges that Census tracts do not represent how most Oregonians identify their community.

However, we are constrained by the data available to us.”

ADOPTED DECISION POINT 2

Census Tracts for the primary geographic unit defining community boundaries for first version



Inclusion of Census County divisions, zip codes, and county boundaries for future versions

Community Designations

ENVIRONMENTAL JUSTICE MAPPING
DECISION POINT 3A

[JUNE 13, 2024 RECORDING LINK](#)

DECISION POINT #3a: COMMUNITY DESIGNATIONS

Why are community designations important?

- Rural, coastal, and remote communities are specifically mentioned in the definition of “environmental justice community” in HB4077.
- Oregon does not have standard definitions for rural, remote, and urban communities.
- Including community designations in the EJ Mapping Tool will support consistency in how agencies use the tool.



DECISION POINT #3a: COMMUNITY DESIGNATIONS

HB4077, Section 10 (c)(4)

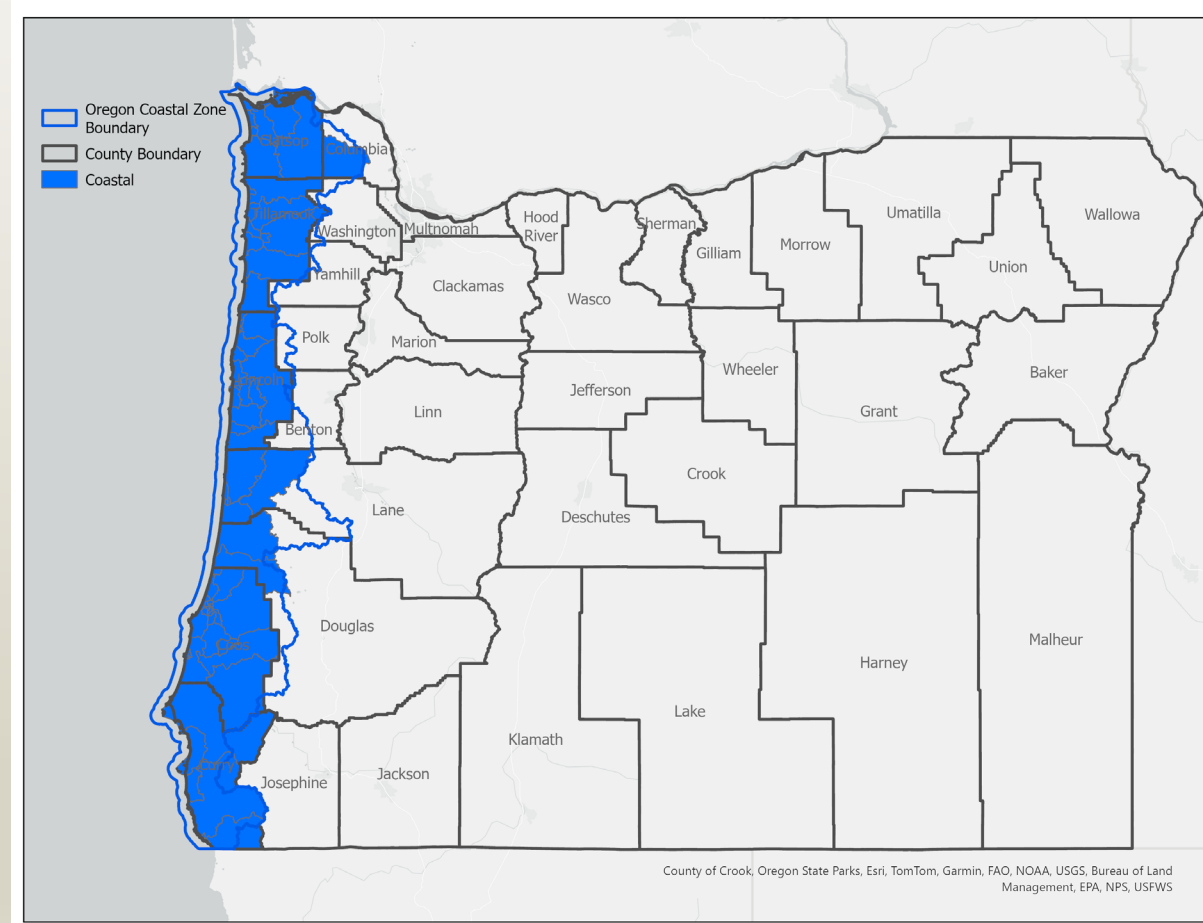
“Environmental justice community” includes communities of color, communities experiencing lower incomes, communities experiencing health inequities, tribal communities, rural communities, remote communities, coastal communities, communities with limited infrastructure and other communities traditionally underrepresented in public processes and adversely harmed by environmental and health hazards, including seniors, youth and persons with disabilities.

DECISION POINT #3a: COMMUNITY DESIGNATIONS

The Environmental Justice Mapping Tool Methodology Workgroup recommends:

Coastal

The Oregon Department of Land Conservation and Development Coastal Zone includes the state's coastal watersheds and extends inland to the crest of the coast range. Census tracts with population centers inside the coastal zone boundary will be designated as coastal.

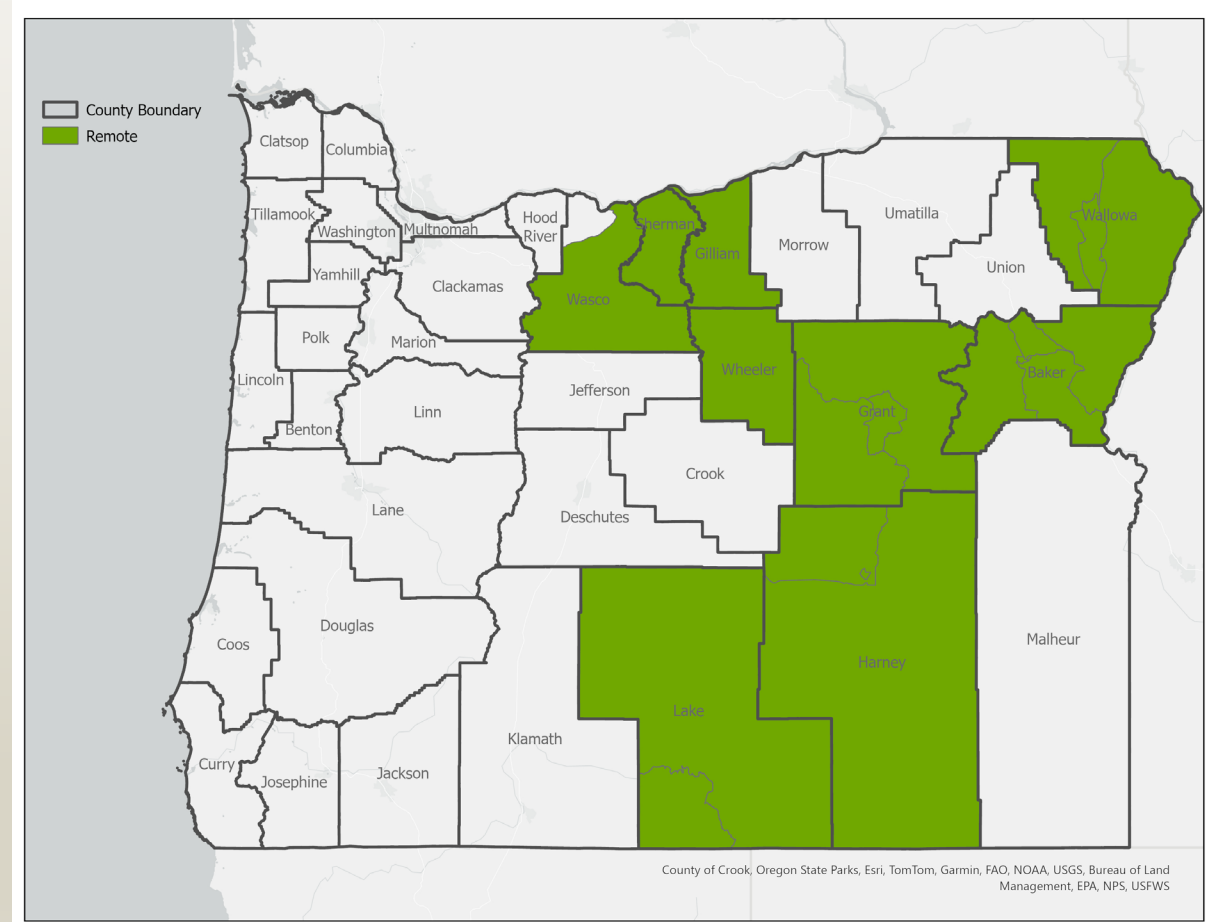


DECISION POINT #3a: COMMUNITY DESIGNATIONS

Remote

USDA Frontier and Remote (FAR) areas are zip codes assigned four levels that are determined by their population and distance from urban places. FAR Level III areas are:

- Places up to 10,000 people.
- 30 minutes or more from an urban area of 10,000-24,999.
- 45 minutes or more from an urban area of 25,000-49,999 people.
- 60 minutes or more from an urban area of 50,000 or more people

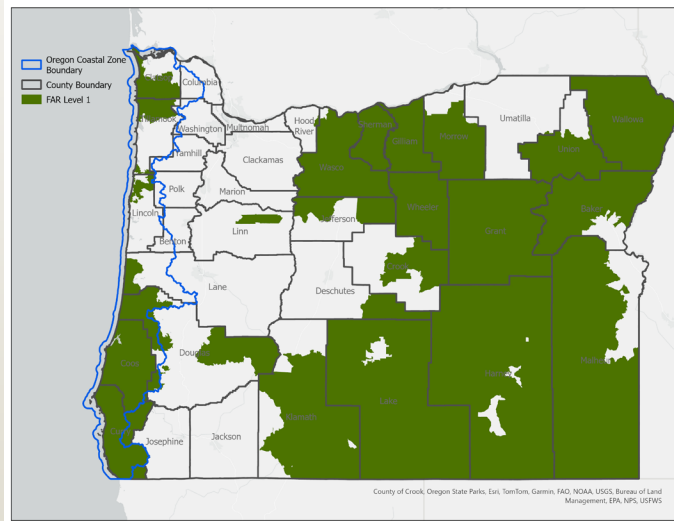


DECISION POINT #3a: COMMUNITY DESIGNATIONS

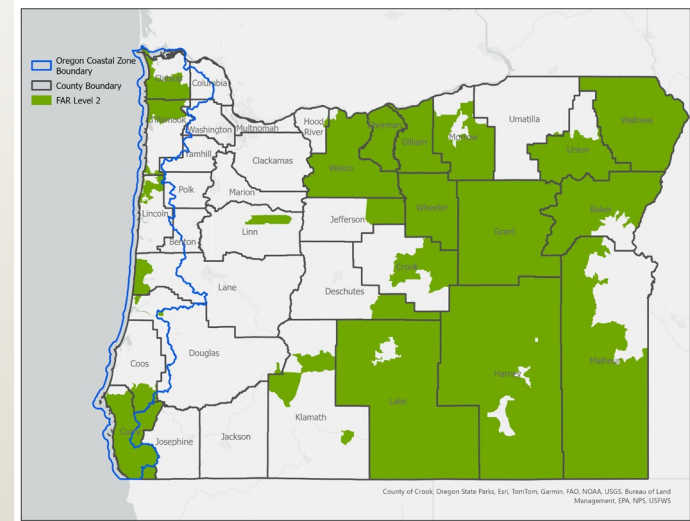
- **Level I FAR** areas consist of rural areas and urban areas up to **50,000 people** that are 60 minutes or more by car from an urban area of 50,000 or more people.
- **Level II FAR** areas consist of rural areas and urban areas up to **25,000 people** that are 45 minutes or more by car from an urban area of 25,000-49,999 people and 60 minutes or more from an urban area of 50,000 or more people.
- **Level III FAR** areas consist of rural areas and urban areas up to **10,000 people** that are 30 minutes or more by car from an urban area of 10,000-24,999, 45 minutes or more from an urban area of 25,000-49,999 people, and 60 minutes or more from an urban area of 50,000 or more people.
- **Level IV FAR** areas consist of rural areas that are 15 minutes or more by car from an urban area of 2,500-9,999 people, 30 minutes or more from an urban area of 10,000-24,999 people, 45 minutes or more from an urban area of 25,000-49,999 people, and 60 minutes or more from an urban area of 50,000 or more people..

DECISION POINT #3a: COMMUNITY DESIGNATIONS

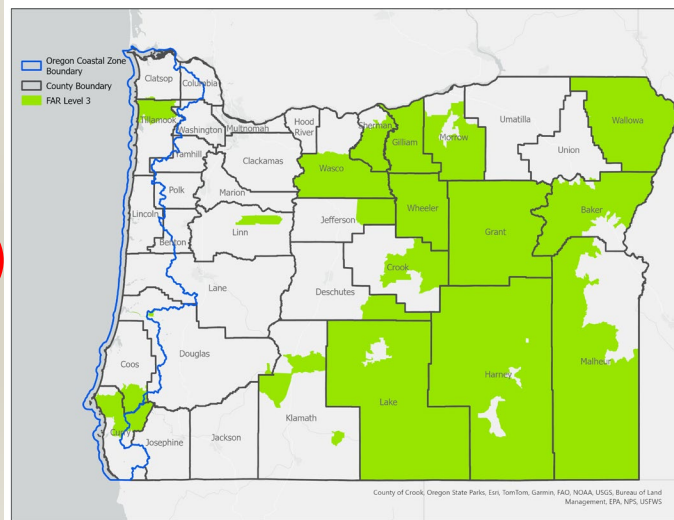
Level 1 FAR
Zip Codes



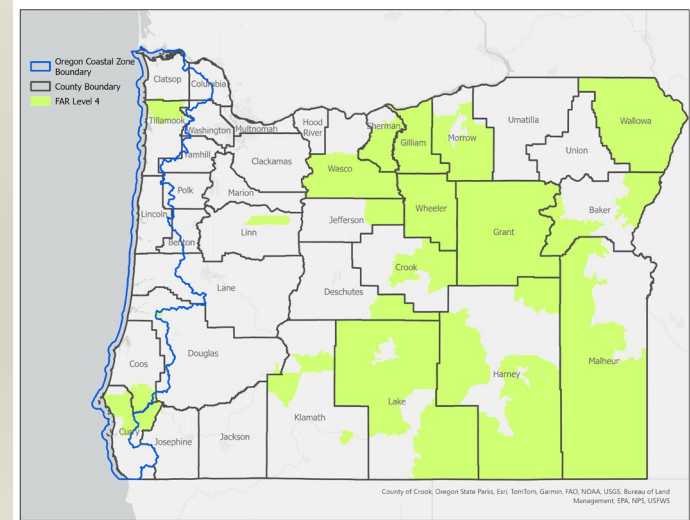
Level 2 FAR
Zip Codes



Level 3 FAR
Zip Codes



Level 4 FAR
Zip Codes

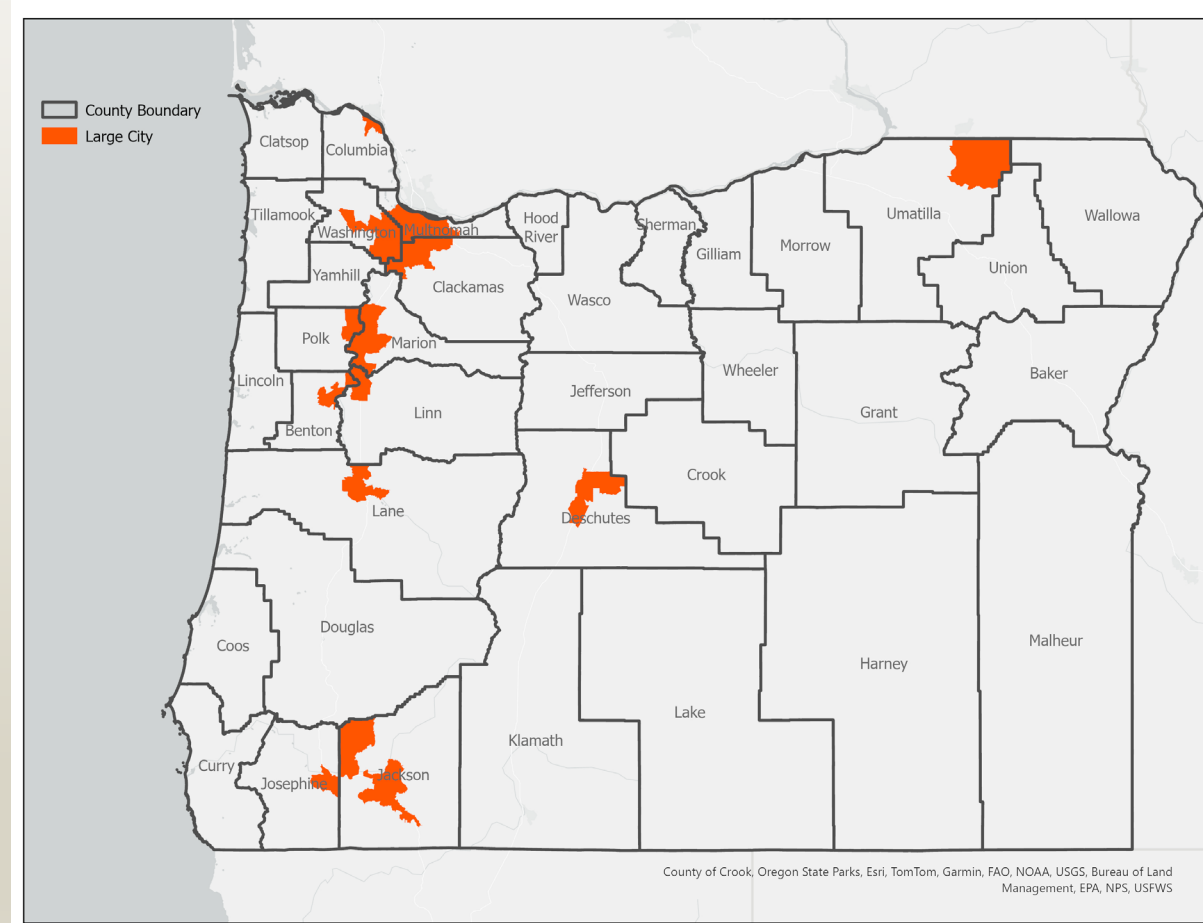


DECISION POINT #3a: COMMUNITY DESIGNATIONS

Large City

USDA Rural/Urban Commute Area
Metropolitan Core Areas.

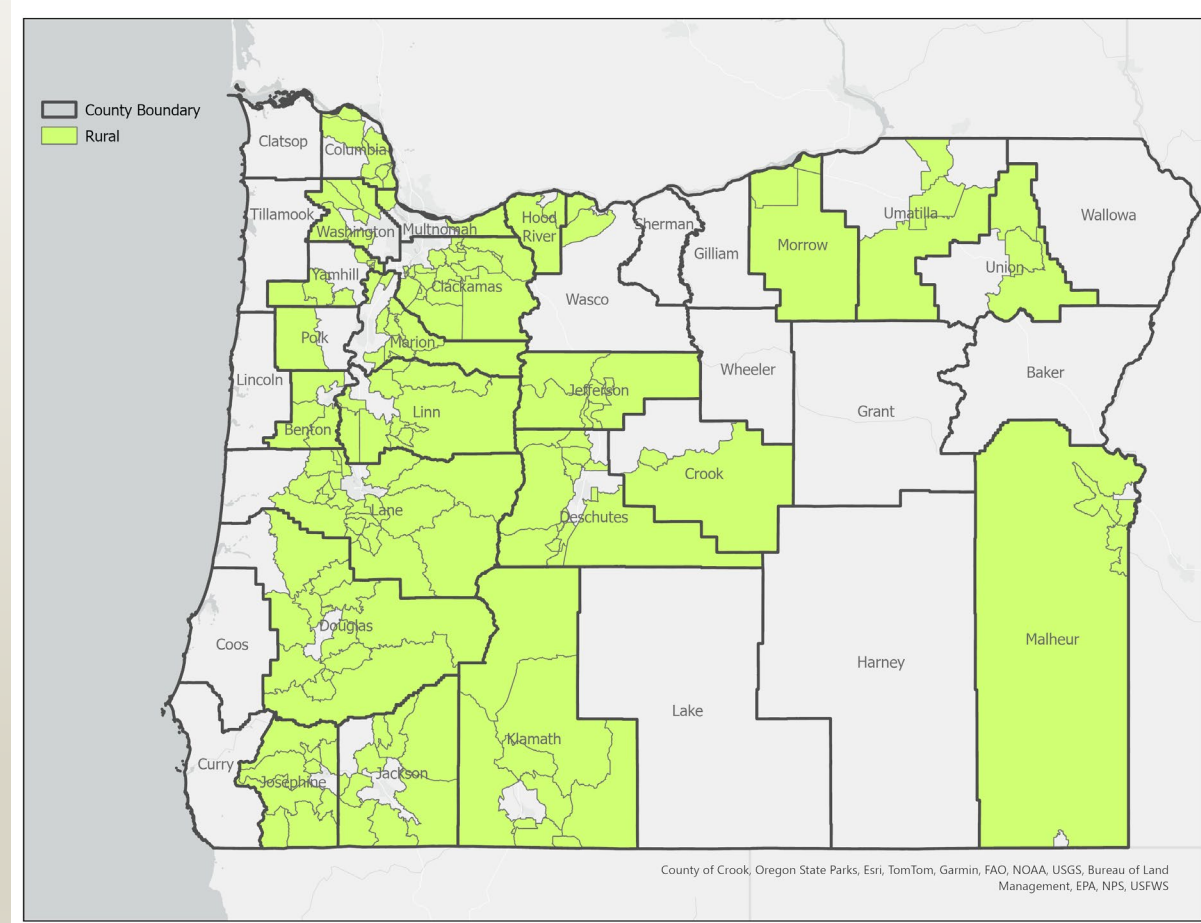
- Metropolitan Core Areas are urban areas (UA) continuously built-up with a population of 50,000 or more,
- And have a primary travel flow within the UA.
- UAs comprise one or more central places and the adjacent densely settled surrounding areas.



DECISION POINT #3a: COMMUNITY DESIGNATIONS

Rural

All census tracts not designated as coastal, remote, or large city will be designated as rural.

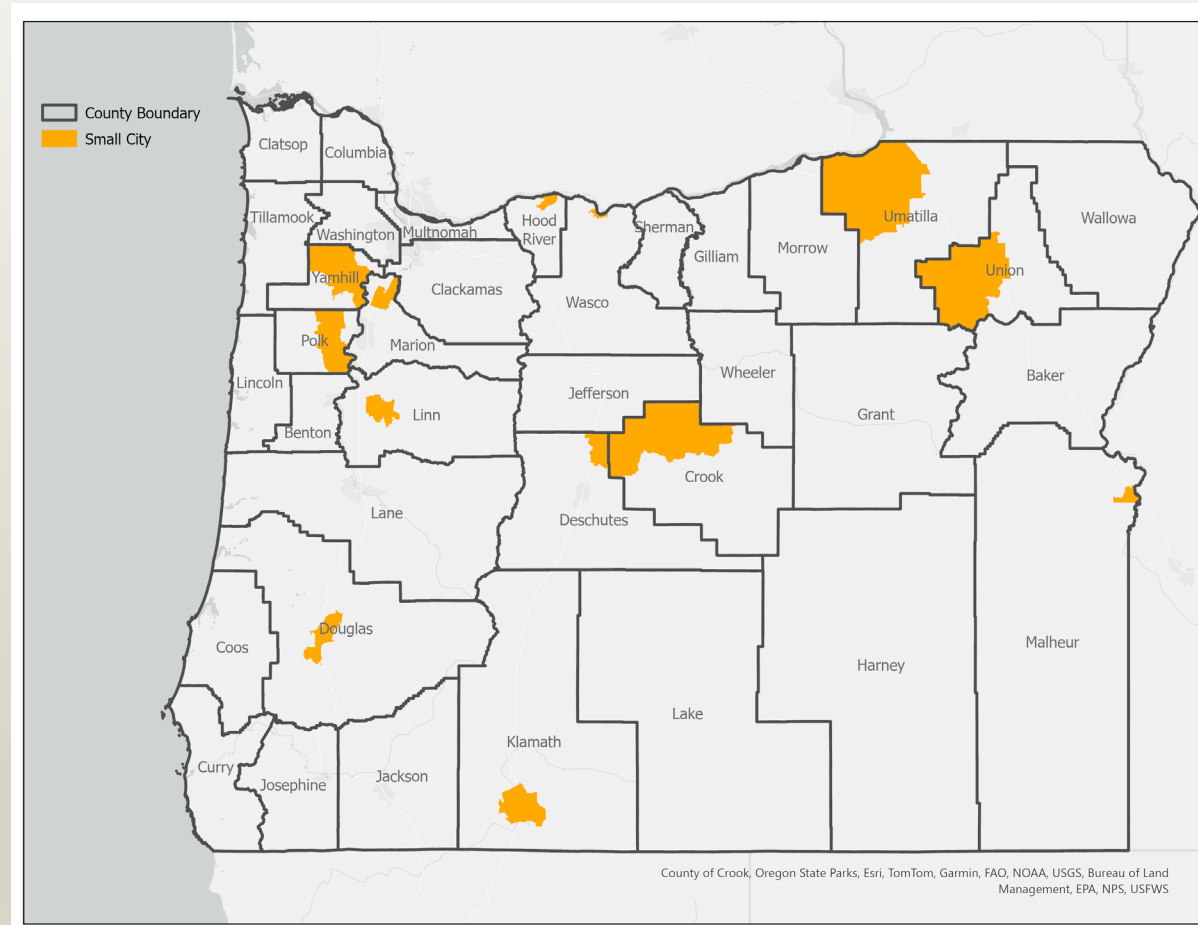


DECISION POINT #3a: COMMUNITY DESIGNATIONS

EJ Council Input:

The Methodology Workgroup did not reach consensus on whether USDA RUCA Micropolitan Core Areas should be designated as Large City (Urban), Rural, or Small City.

- Micropolitan Core Areas are Rural-Urban Commute Areas with primary travel flows inside an urban cluster of 10,000 – 49,999 people.
- Examples of Micropolitan Core Areas are Hermiston, Hood River, Klamath Falls, La Grande, Ontario, Pendleton, Roseburg, and The Dalles, etc.



DECISION POINT #3a: COMMUNITY DESIGNATIONS

Environmental Justice Council Input:

Micropolitan Core Areas

The Methodology Workgroup does not have enough information to recommend whether Micropolitan Core Areas should be designated as large city, rural, or small city. Therefore, they recommend the EJ Council make the determination or wait for feedback from the community listening sessions.

- **Large City** – Micropolitan Core Areas tend to have similar infrastructure as Metropolitan Core Areas including access to healthcare, shopping, government services, highspeed internet, and educational opportunities.
- **Rural** – Micropolitan Core economies tend to align more closely with rural tracts. Natural resources jobs: Rural = 27.6%, Micropolitan = 24.7%, Large City = 14.4%.

DECISION POINT #3a: COMMUNITY DESIGNATIONS

CDC Environmental Justice Index Rural/Large City Comparisons to Micropolitan Core Areas:

Environmental Burden Module

Designation	Total 2010 tracts by designation	Top 20% of worst EBM scores statewide	Percent of tracts in top 20% by designation	Mean EBM score in top 20%	Overall mean EBM score
Coastal	63	0	0%	0.00	0.12
Remote	19	0	0%	0.00	0.13
Large City	508	147	29%	0.76	0.45
Rural	158	5	3%	0.75	0.23
Small City	77	13	17%	0.80	0.46
Total	825	165			

Social Vulnerability Module

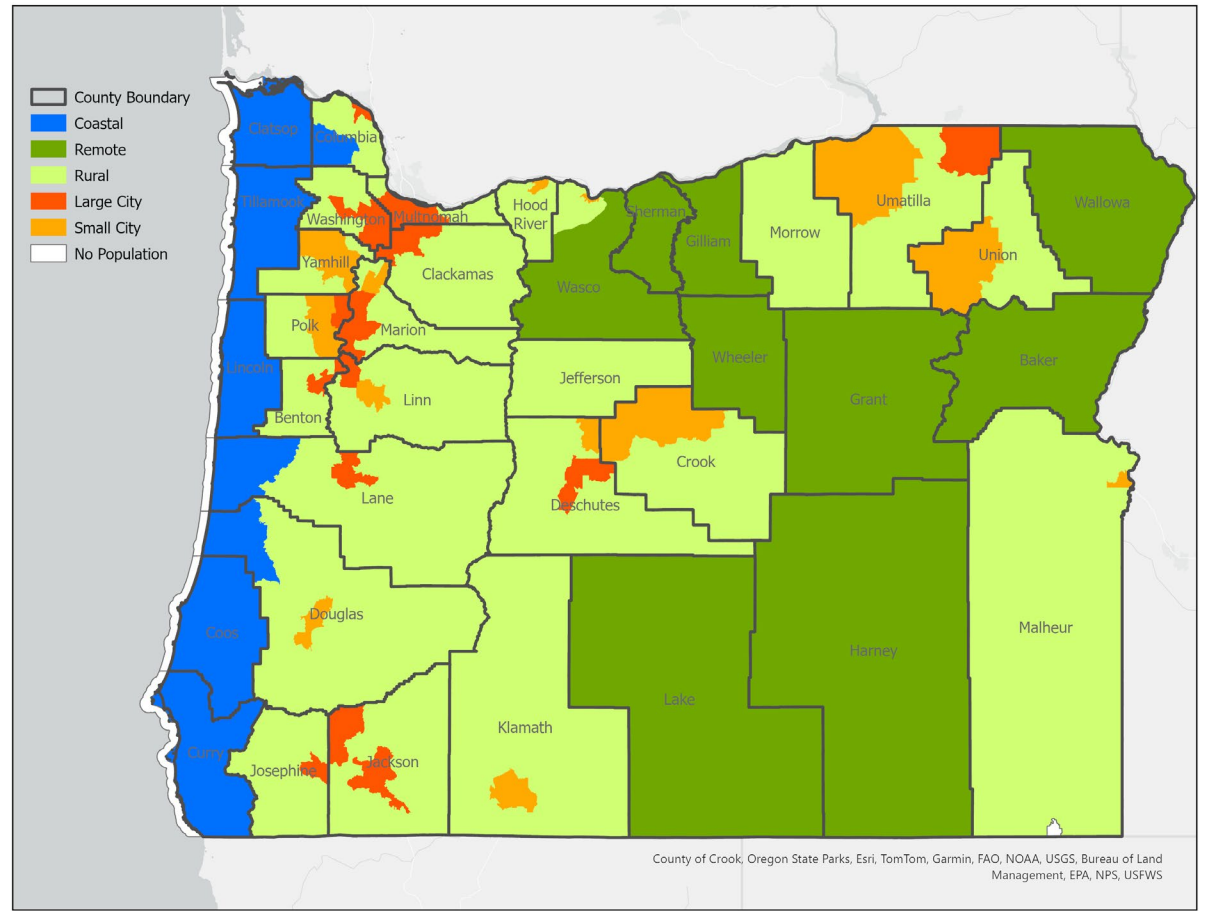
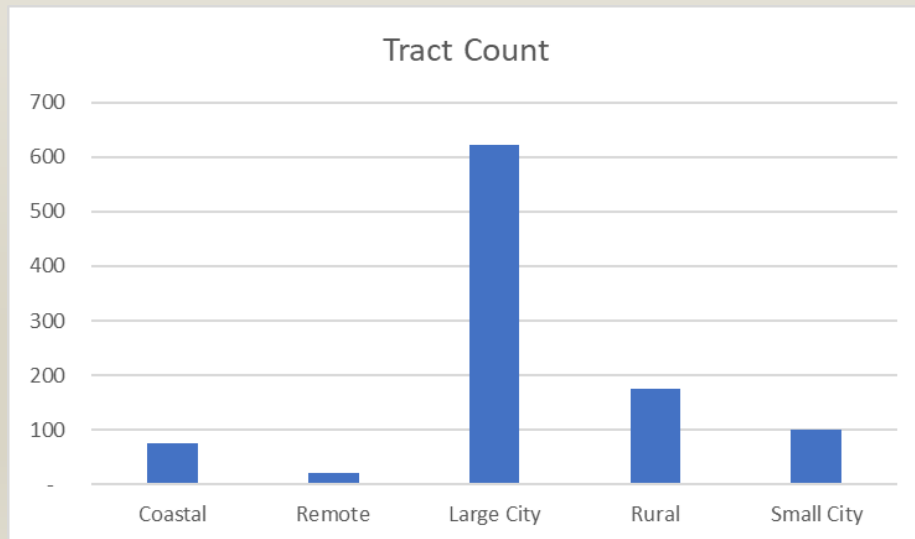
Designation	Total 2010 tracts by designation	Top 20% of worst SVM scores statewide	Percent of tracts in top 20% by designation	Mean SVM score in top 20%	Overall mean SVM score
Coastal	63	13	21%	0.82	0.63
Remote	19	2	11%	0.83	0.68
Large City	508	89	18%	0.87	0.46
Rural	158	31	20%	0.82	0.54
Small City	77	30	39%	0.86	0.69
Total	825	165			

Health Vulnerability Module - HVM uses one significant digit, so it includes ties in the top 20%

Designation	Total 2010 tracts by designation	Top 20% of worst HVM scores statewide	Percent of tracts in top 20% by designation	Mean HVM score in top 20%	Overall mean HVM score
Coastal	63	43	68%	0.82	0.68
Remote	19	16	84%	0.80	0.74
Large City	508	44	9%	0.69	0.27
Rural	158	65	41%	0.78	0.52
Small City	77	25	32%	0.79	0.50
Total	825	193			

DECISION POINT #3a: COMMUNITY DESIGNATIONS

Designation	Tract Count	Population 2020	Area in Square Miles
Coastal	76	230,134	7,889
Remote	21	55,047	35,257
Large City	621	2,749,784	2,438
Rural	175	697,836	47,628
Small City	100	443,545	4,012
No Population	8	-	1,155
Total	1,001	4,176,346	98,378

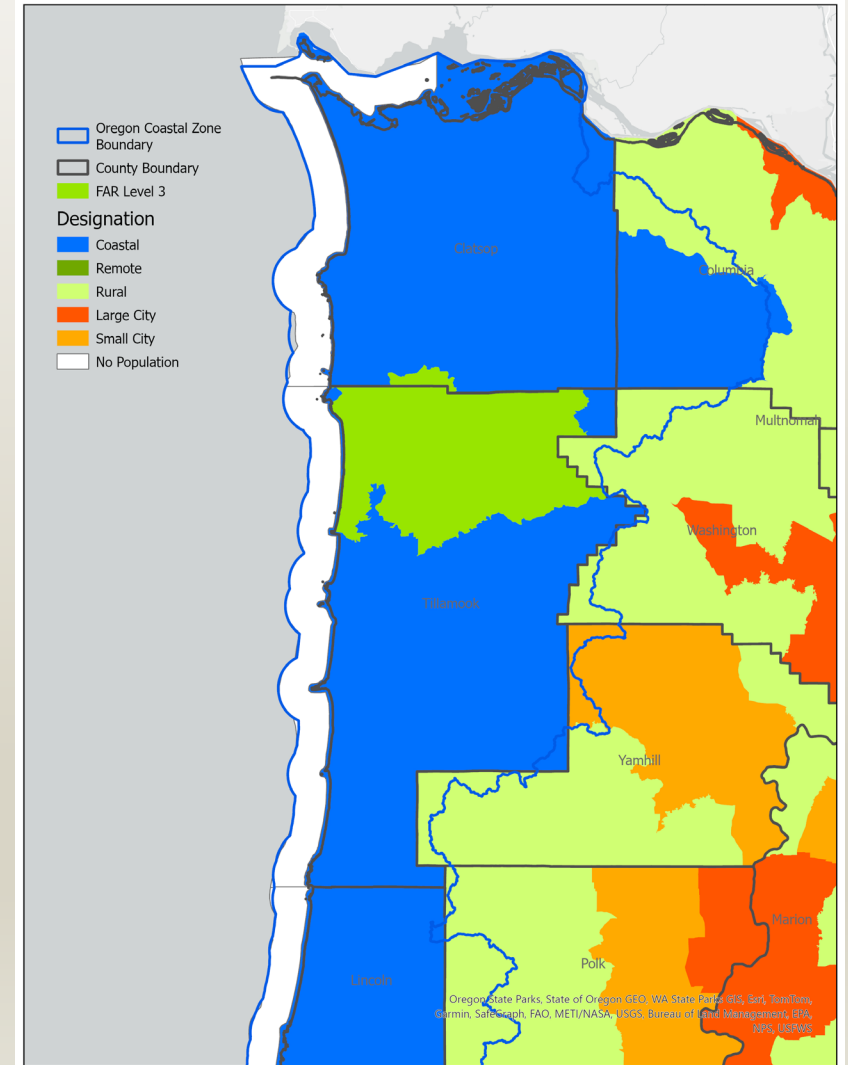


DECISION POINT #3a: COMMUNITY DESIGNATIONS

Can a community have two designations?

What if a coastal community overlaps with another designation definition (e.g., Micropolitan Core Area or FAR Level III zip code)?

Some climate change risks mentioned in HB4077 will impact coastal communities much more than inland communities including sea level rise and ocean acidification. Therefore, the Methodology Workgroup recommends that the coastal designation take precedent over other designations inside the coastal zone.



DECISION POINT #3a: COMMUNITY DESIGNATIONS

Methodology Workgroup Rationale:

1. Coastal

The DLCD Coastal Boundary is a state standard and is included in the Oregon Data Framework.

2. Remote

- A. HB4077, Section 10(9): “Remote community” means a community with low population density and high geographic remoteness.
- B. Criteria used for remote communities were population size, and limited access to healthcare and amenities like a full-service supermarket.
- C. USDA Data source is the same used by Oregon Rural Health.
- D. USDA Frontier and Remote Areas I & II were not selected because those areas include micropolitan core areas with urban amenities.
- E. Sub-county data sources were prioritized so tracts in counties with micropolitan core areas were not excluded from the designation.

DECISION POINT #3a: COMMUNITY DESIGNATIONS

Methodology Workgroup Rationale:

3. Large City

USDA Rural-Urban Commute Areas Metropolitan Core Area were selected because they include the U.S. Census Urban Area density threshold, continuous development, and travel primarily within the area.

Note: Urban-Rural Commute Areas with 2020 Census data will not be available until fall 2024.

4. Rural

None of the data sources evaluated by the Methodology Workgroup included both rural AND remote designations. Therefore, rural areas were selected as places outside of large city, small city, coastal and remote areas.

ADOPTED DECISION POINT 3a

- COASTAL
- REMOTE
- LARGE CITY
- SMALL CITY
- RURAL
- STATEWIDE

1. Coastal: The DLCD Coastal Boundary is a state standard and is included in the Oregon Data Framework.
2. Remote
 1. HB4077, Section 10(9): “Remote community” means a community with low population density and high geographic remoteness.
 2. Criteria used for remote communities were population size, and limited access to healthcare and amenities like a full-service supermarket.
 3. USDA Data source is the same used by Oregon Rural Health.
 4. USDA Frontier and Remote Areas I & II were not selected because those areas include micropolitan core areas with urban amenities.
 5. Sub-county data sources were prioritized so tracts in counties with micropolitan core areas were not excluded from the designation.
3. Large City: USDA Rural-Urban Commute Areas Metropolitan Core Area were selected because they include the U.S. Census Urban Area density threshold, continuous development, and travel primarily within the area.
4. Rural: None of the data sources evaluated by the Methodology Workgroup included both rural AND remote designations. Therefore, rural areas were selected as places outside of large city, small city, coastal and remote areas.

Community Comparisons

ENVIRONMENTAL JUSTICE MAPPING
DECISION POINT 3B

[JUNE 13, 2024 RECORDING LINK](#)

DECISION POINT #3b: COMMUNITY COMPARISONS

Why are community comparisons important?

- HB4077 provides examples of environmental burdens and climate change risks specific to community designations (e.g., sea level rise, ocean acidification, water insecurity, etc.).
- Most state environmental justice mapping tools compare communities statewide because their intent is to identify communities with the highest levels of cumulative impacts relative to all other communities.
- A major concern expressed by communities in states where policies and state investments are influenced by an index score is environmental burdens, climate change risks, and economic disparities can be very different depending on where you live in the state.

DECISION POINT #3b: COMMUNITY COMPARISONS

The Methodology Workgroup recommends the EJ Mapping Tool include the following two options:

1. The ability to compare communities by designation.
 - a. Large City to Large City
 - b. Rural to Rural
 - c. Coastal to Coastal
 - d. Remote to Remote
 - e. Small City to Small City (optional)
- The designation indices can vary either by using different indicators for the designations OR by adjusting the weights of indicators or indicator subdomains.

DECISION POINT #3b: COMMUNITY COMPARISONS

- 
2. Optional ability to compare communities across the state with a standard statewide index score using the same indicators if needed by state agencies.
- The Methodology Workgroup is concerned that providing a statewide index score along with a designation index score may be confusing for users.
 - The EJ Mapping Tool Leadership Team, Methodology Workgroup, and Liaison Workgroup will work with the EJ Council to provide guidance on when the different options should be used and how they should be applied.

DECISION POINT #3b: COMMUNITY COMPARISONS

Methodology Workgroup Rationale:

1. Statewide community comparisons are unable to account for regional, environmental and social differences which can result in diverting state funds away from EJ communities potentially contributing to environmental injustices,
2. Community designations were selected instead of regions because none of the state regions we evaluated group environmentally similar communities as well as the designations recommended in decision point 3a.
3. The Methodology Workgroup anticipates there may be the need for some state agencies to compare Oregon communities using a statewide index score in their rule making and infrastructure investment processes.

DECISION POINT #3a & b: Council Decision

EJ Council decisions needed for Decision Point 3:

1. Community designation definitions (3a)?
2. How to determine Micropolitan Core Area designation (large city, rural or small city) (3a)?
3. How communities will be compared – by designation, across the state, both (3b)?



ADOPTED DECISION POINT 3b

- COASTAL TO COASTAL
- REMOTE TO REMOTE
- LARGE CITY TO LARGE CITY
- SMALL CITY TO SMALL CITY
- RURAL TO RURAL
- STATEWIDE

- Statewide community comparisons are unable to account for regional, environmental and social differences which can result in diverting state funds away from EJ communities potentially contributing to environmental injustices,
- Community designations were selected instead of regions because none of the state regions we evaluated group environmentally similar communities as well as the designations recommended in decision point 3a.
- The Methodology Workgroup anticipates there may be the need for some state agencies to compare Oregon communities using a statewide index score in their rule making and infrastructure investment processes.

Weighting Methods

ENVIRONMENTAL JUSTICE MAPPING
DECISION POINT 4

[AUGUST 7, 2024 RECORDING LINK](#)

[OCTOBER 10, 2024 RECORDING LINK](#)

DECISION POINT #4 – WEIGHTING METHODS

- No weighting – CDC Environmental Justice Index/Environmental Justice Screening Method
- Subdomain weighting – CalEnviroScreen/Washington Environmental Health Disparities Map/Colorado EnviroScreen
- Regression domain weighting – California Healthy Places Index
- Principal component analysis – EPA Environmental Quality Index
- Participatory methods – technical experts + community preference surveys + statistics

DECISION POINT #4 – Method Evaluation

Build a working dataset for Oregon Census tracts

- Select Indicators from the U.S. Climate Vulnerability Index
- Categorize indicators by subdomain – environmental exposures, environmental hazards, climate change risks, built environment, human health, social factors
- Standardize raw indicator values as percentiles
- Analyze weighting methods
- Compare results – tracts in the 80th percentile by community designation

DECISION POINT #4

Equal Weighting Method - CDC Environmental Justice Index

Environmental
Exposures

+

Environmental
Hazards

+

Climate
Change Risks

+

Built
Environment

+

Human
Health

+

Social
Factors

- All indicators and domains are weighted equally.
- Domains are only weighted the same if they have an equal number of indicators.

"Due to a lack of scientific evidence supporting a specific weighting scheme, all modules are weighted equally in calculating the Overall EJI Score."

DECISION POINT #4

Equal Weighting Method - Considerations

- The weighting method is easy to explain.
- The only way to balance domain weighting is by including an equal number of indicators in each domain.
- We will have no rationale for weighting indicators independently.
- Strategic indicator selection will be required to assure community concerns are prioritized.

DECISION POINT #4

Subdomain Weighting Method - Colorado EnviroScreen

PLACE
Environmental Exposures x 1.0 +
Environmental Hazards x 0.5 +
Climate Change Risks x 0.5 +
Built Environment x 0.5
÷ 2.5

X

PEOPLE
Human Health +
Social Factors
÷ 2.0

DECISION POINT #4

Subdomain Weighting Method - Considerations

- The subdomain weighting method is slightly more difficult to explain than equal weighting.
- We do not currently have a rationale for weighting climate change risk and the built environment half as much as environmental exposures.
- As with equal weighting, we will not have a rationale for weighting indicators independently.
- Strategic indicator selection will be required to assure community concerns are prioritized.

DECISION POINT #4

Regression Weighting Method - California Healthy Places Index



- Domains are weighted by the strength of their relationship with life expectancy at birth.
- All domains are guaranteed a minimum of 5% weight.

DECISION POINT #4

Regression Weighting Method - Considerations

The Methodology Workgroup determined that a regression weighting method is not a good fit because:

- Life expectancy at birth has much stronger associations with human health and social factors than environmental indicators. Therefore, environmental concerns are undervalued in the model.
- The Oregon EJ Mapping Tool is directed to be an environmental justice tool, not a social determinants of health tool.

DECISION POINT #4

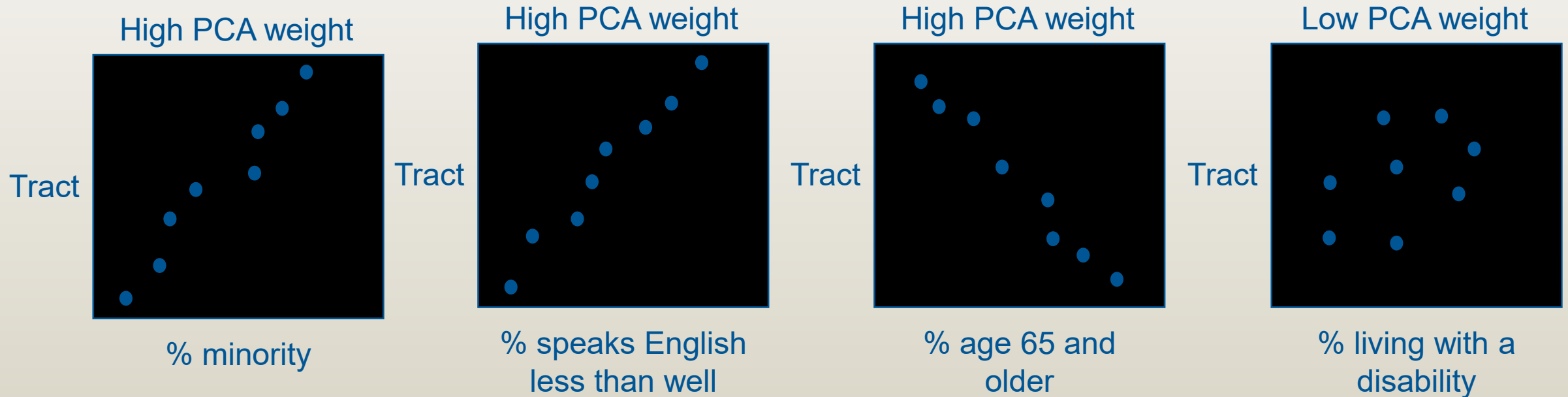
Principal Component Analysis – EPA Environmental Quality Index



- PCA is a technique used to simplify data and make it easier to analyze.
- Indicators are loaded into a variance matrix and the indicators are weighted based on their relationships with the other indicators inside the domain.
- Indicators with higher variation in their scores will receive higher weights. Indicators with lower variation in their scores will receive lower weights.

DECISION POINT #4

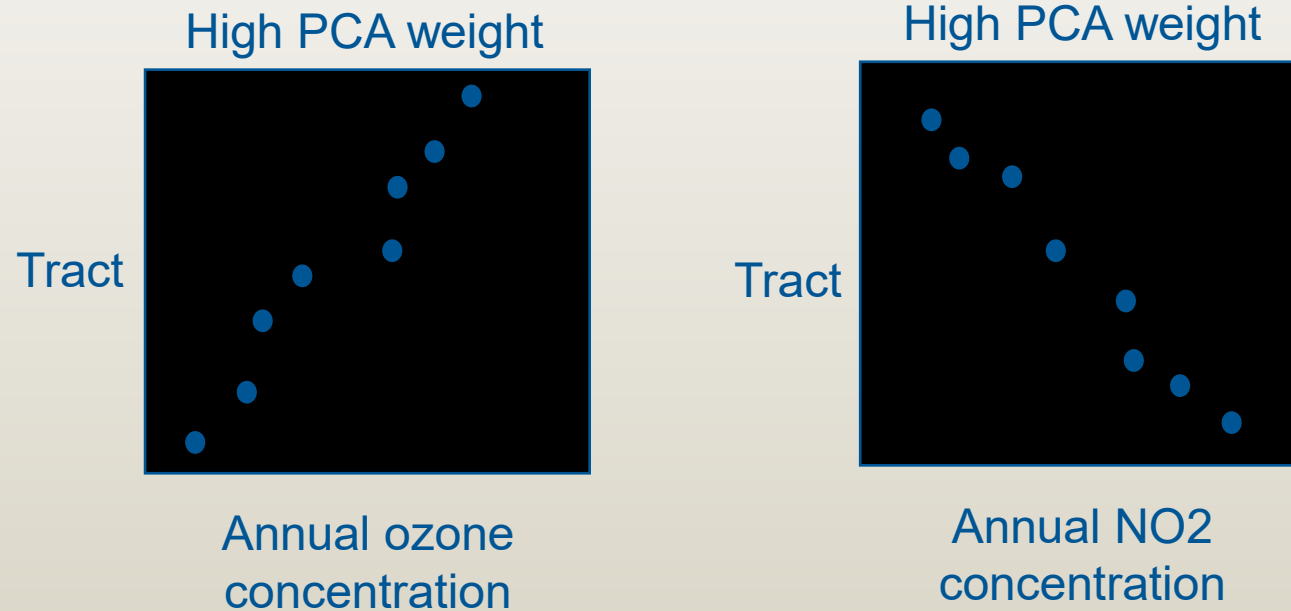
Principal Component Analysis Weighting



- There is a positive relationship between communities of color and people who speak English less than well with high variation in indicator scores.
- There is an inverse relationship with older populations, but similar variation in indicator scores.
- There is low variation in indicator scores for people living with a disability

DECISION POINT #4

Principal Component Analysis Weighting



Tract X:
NO2 = 0.98
+
Ozone = 0.02
AQ index score = 0.5

- Tracts with high NO2 concentrations tend to have low ozone levels.
- Some inverse relationships can cause indicators to cancel each other out.
- This means we will need to be very strategic with indicator selection.

DECISION POINT #4

Principal Component Analysis Weighting Method - Considerations

Principal component analysis is complex and more difficult to explain than equal weighting and subdomain weighting.

Indicator weighting is determined by variance in the data, not impact on human health or quality of life. Strategic indicator selection will be required to assure community concerns are prioritized.

It is possible to develop a rationale for indicator weight adjustments.

DECISION POINT #4

Participatory Methods

Participatory methods incorporate input from various stakeholders like technical experts, citizens, and elected officials to help assign weights.

- Budget Allocation – a budget of N points is given to experts to allocate to a small number of indicators. Community surveys are helpful.
- Analytical Hierarchy Process - experts identify the problem to be solved, possible solutions, and the criteria used to judge the alternatives.
- Conjoint Analysis - survey-based statistical technique that incorporates the preferences of individuals (e.g., experts or the public).

DECISION POINT #4

Participatory Weighting Methods - Considerations

- Participatory methods can be used to combine community input with statistical analysis to create weighting schemes.
- Conjoint analysis is a good fit for developing community-driven indicator weighting because it relies heavily on community preference.
- Data collection for participatory weighting is time and labor-intensive requiring input from communities and technical experts.

DECISION POINT #4 – DOMAIN WEIGHTING

Introduction

Indicator weights represent the relative importance of each indicator as it contributes to the index.

If an index does not apply any weights explicitly, the indicators will be equally weighted. However, if some indicators or domains “matter” more than others, different weighting should be applied.

Whether choosing to keep equal weights or alter weights to favor indicators, the choice of weights is subjective and should be backed by a strong rationale.

DECISION POINT #4 – DOMAIN WEIGHTING



Why is weighting so complicated?

DECISION POINT #4 – DETERMINANTS OF HEALTH



Social and Environmental Determinants of Health

What Accounts for Differences in Health?

- Genetics (5%)
- Personal Behaviors (30%)
- Quality of Health Care (10%)
- Social and Environmental Conditions (55%)

Image source: Whitehead, M. & Dahlgren, G. (1991). What can we do about inequalities in health? *The Lancet*, 338, 1059-1063.

DECISION POINT #4 – CUMULATIVE RISK ASSESSMENT



Setting - Community
Pathway - Ambient Air
Exposure – Inhalation
Stressor – Nitrogen Dioxide
Exposure Time – 2 years
Exposure Concentration – 250 ppb

Short-Term Health Risks

- Eye irritation
- Coughing
- Wheezing

Long-Term Health Risks

- Reduced lung function
- Heart attack

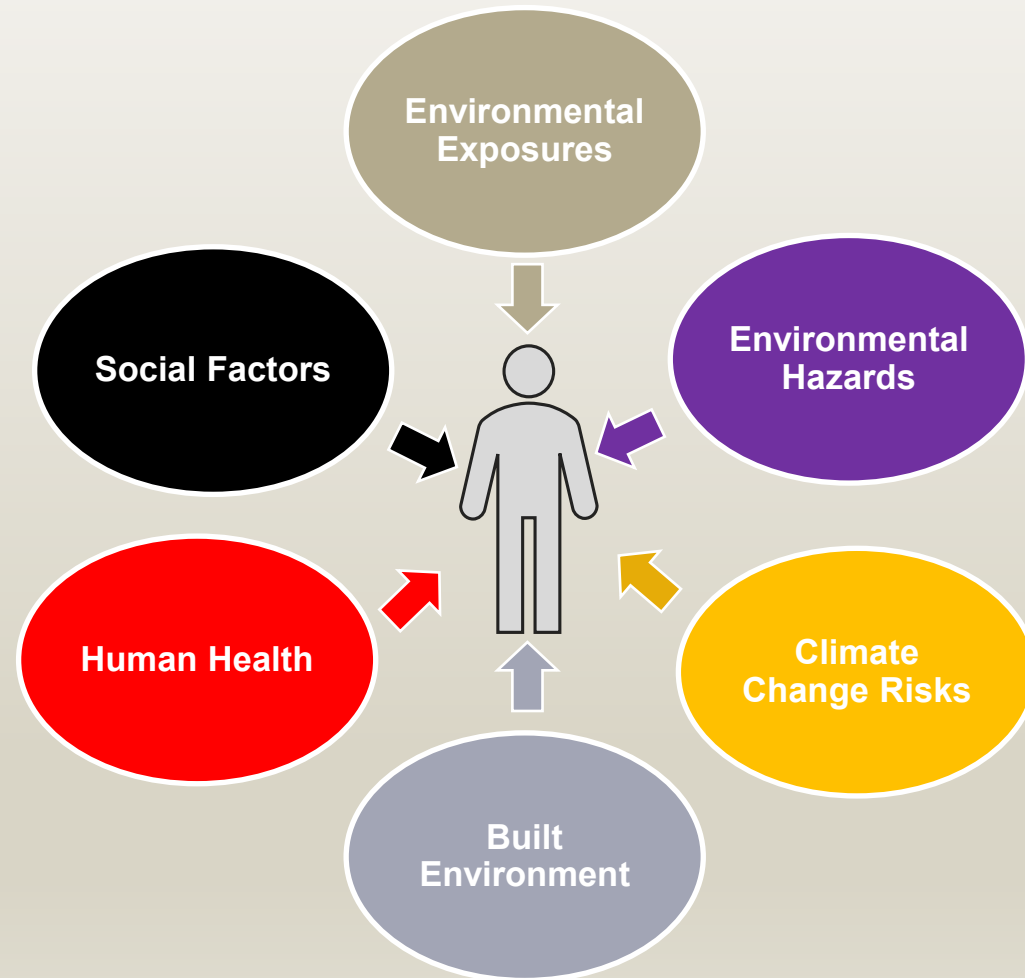
Stressors

- Age
- Sex
- Race/Ethnicity
- Economic status
- Individual behavior
- Pre-existing health conditions

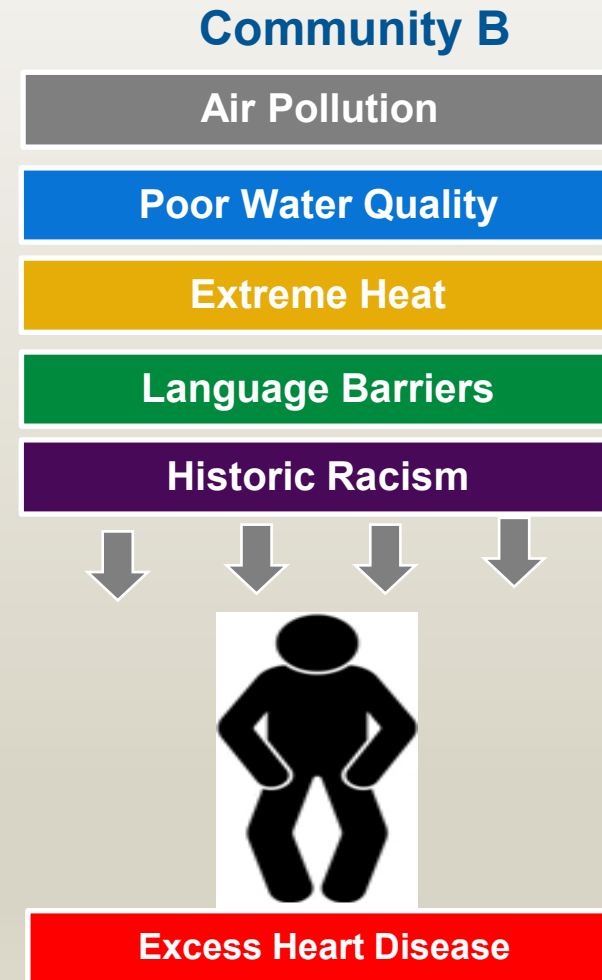
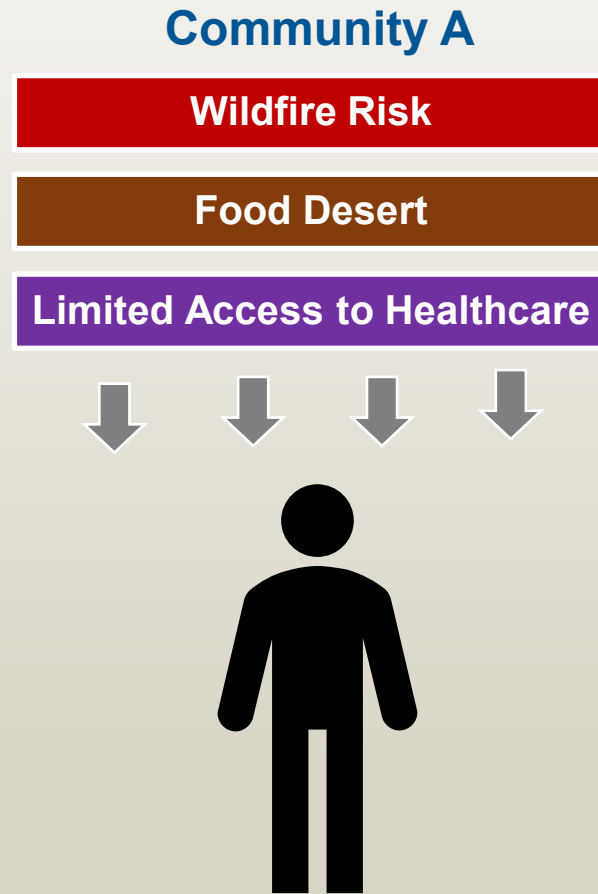
Framework for Cumulative Risk Assessment. –EPA (May 2023)

DECISION POINT #4 – CUMULATIVE IMPACTS

“The total harm to human health that occurs from the combination of environmental burden such as pollution and poor environmental conditions, pre-existing health conditions, and social factors such as access to quality healthcare.”
-HHS (2022)



DECISION POINT #4 – CUMULATIVE IMPACTS



DECISION POINT #4 – WHAT WE KNOW

- Some of the environmental burdens listed in HB4077 affect human health and quality of life very differently. For example, environmental exposures impact communities differently than environmental hazards or climate change risks, although they can be related.
- Environmental burdens affect individual health unequally in ways that can be difficult to quantify.
- Some environmental burdens impact communities more inequitably than others.
- There are inverse relationships between some environmental burdens. For example, communities experiencing low PM2.5 concentrations can experience high ozone concentrations.

DECISION POINT #4 – WEIGHTING METHODS



NO WEIGHTING -
ALL WEIGHTS AND
DOMAINS ARE
WEIGHTED THE
SAME FACILITATING
EASY
INTERPRETATION OF
THE INDEX BY A
RANGE OF END-
USERS.



CALENVIROSCREEN
WEIGHTING -
ENVIRONMENTAL
HAZARD AND
CLIMATE
VULNERABILITY
DOMAINS ARE
WEIGHTED HALF AS
MUCH AS
ENVIRONMENTAL
EXPOSURES
BECAUSE THE
POPULATION MAY
NOT BE DIRECTLY
OR REGULARLY
EXPOSED TO
HAZARDS AND
CLIMATE CHANGE
RISKS. HUMAN
HEALTH AND
SOCIAL FACTORS
ARE WEIGHTED
EQUALLY.



PRINCIPAL
COMPONENT
ANALYSIS -
INDICATOR
WEIGHTS ARE
DETERMINED BY
VARIANCE IN THE
DATA AND
INFLUENCE OF EACH
INDICATOR ON THE
SUBDOMAIN.
DOMAINS ARE
AGGREGATED AFTER
INDICATORS ARE
WEIGHTED.



CONJOINT
ANALYSIS -
COMMUNITY
PREFERENCE
SURVEYS +
TECHNICAL EXPERT
INPUT.

DECISION POINT #4 – METHOD EVALUATION

Equal Weighting Method - CDC Environmental Justice Index

Environmental
Exposures

+

Environmental
Hazards

+

Climate
Change Risks

+

Built
Environment

+

Human
Health

+

Social
Factors

- All indicators and domains are weighted equally.
- For example, if a domain has 6 indicators, each indicator will receive a weight of 16.67% (100/6).
- Domains are only weighted the same if they have an equal number of indicators.

"Due to a lack of scientific evidence supporting a specific weighting scheme, all modules are weighted equally in calculating the Overall EJI Score." ~CDC/ATSDR, 2022

DECISION POINT #4 – METHOD EVALUATION

Subdomain Weighting Method - Colorado EnviroScreen

PLACE
Environmental Exposures x 1.0
+
Environmental Hazards x 0.5
+
Climate Change Risks x 0.5
+
Built Environment x 0.5
÷ 2.5

X

PEOPLE
Human Health x 1.0
+
Social Factors x 1.0
÷ 2.0

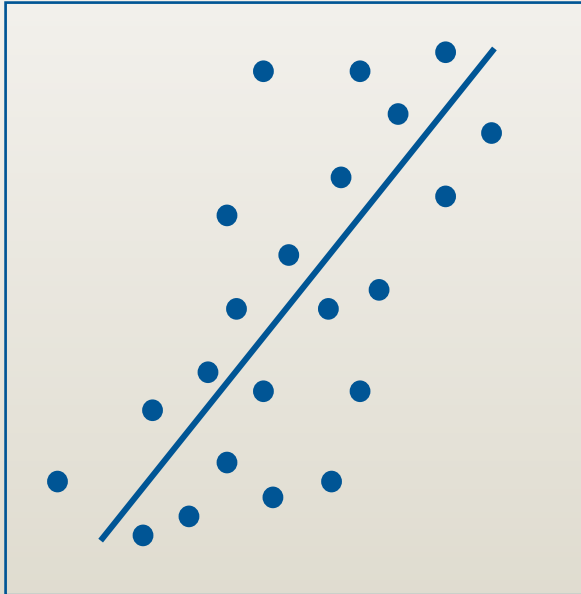
DECISION POINT #4 – METHOD EVALUATION

Principal Component Analysis – EPA Environmental Quality Index

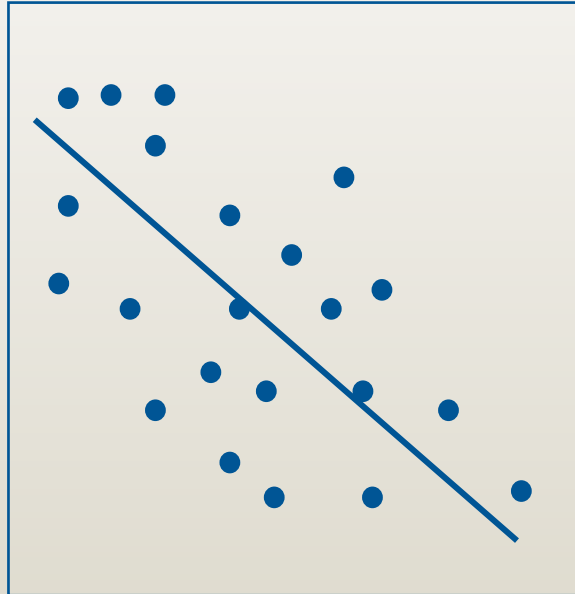


- In PCA individual indicators are weighted instead of the domains. The indicator weights then influence the domain weights.
- PCA measures the covariance between indicator scores. In other words, PCA measures the magnitude of inequities that exist between communities for selected indicators.
- Indicators are loaded into a covariance matrix and weighted based on their variance compared to other indicators.

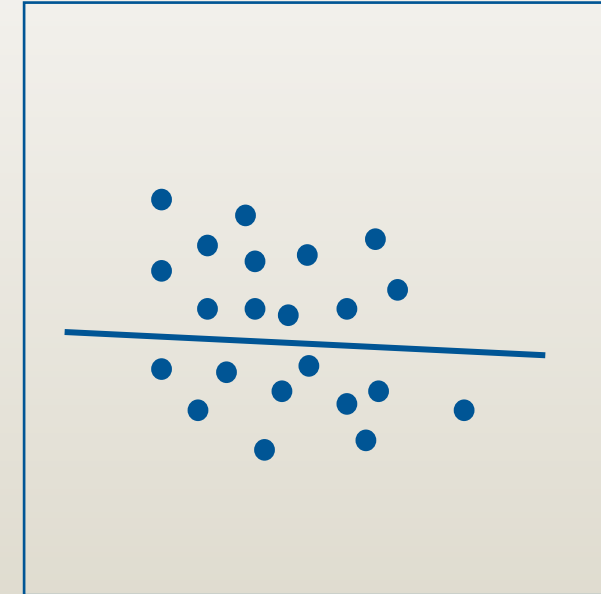
DECISION POINT #4 – METHOD EVALUATION



High positive covariance
(Household income)



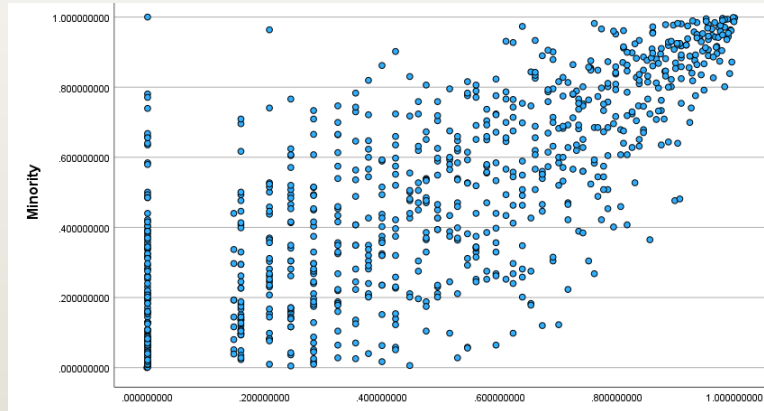
High negative covariance
(People 65 and older)



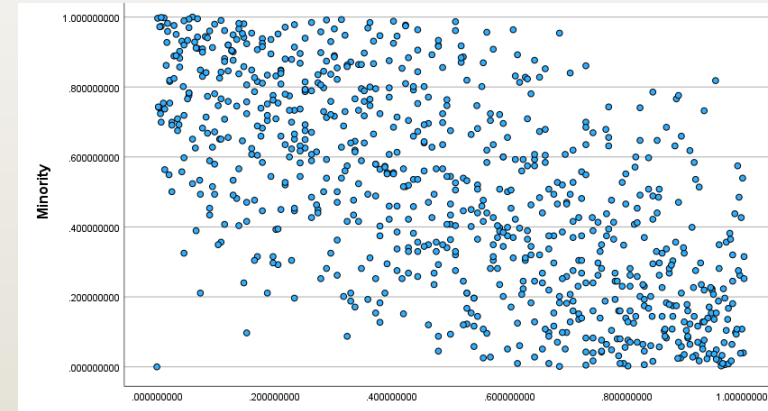
Low negative covariance
(Percent unemployed)

- Indicators with higher variation (inequities) will receive higher weights. Indicators with lower variation in their scores will receive lower weights.

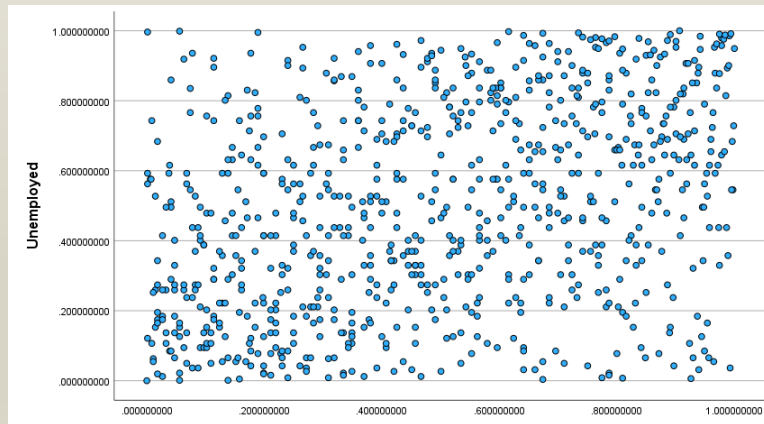
DECISION POINT #4 – METHOD EVALUATION



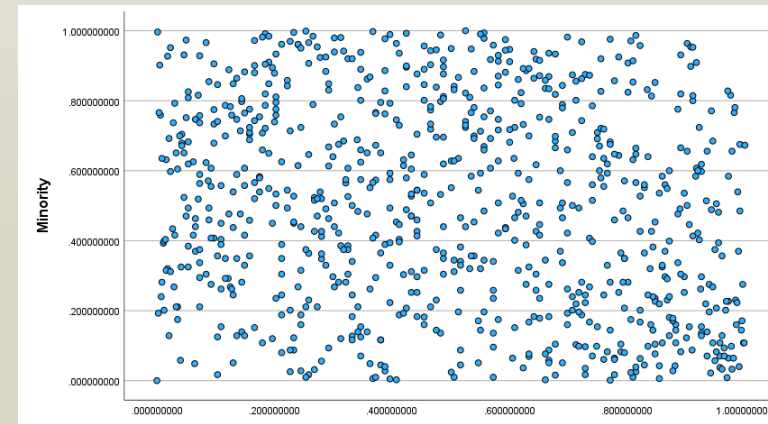
High positive covariance



High negative covariance

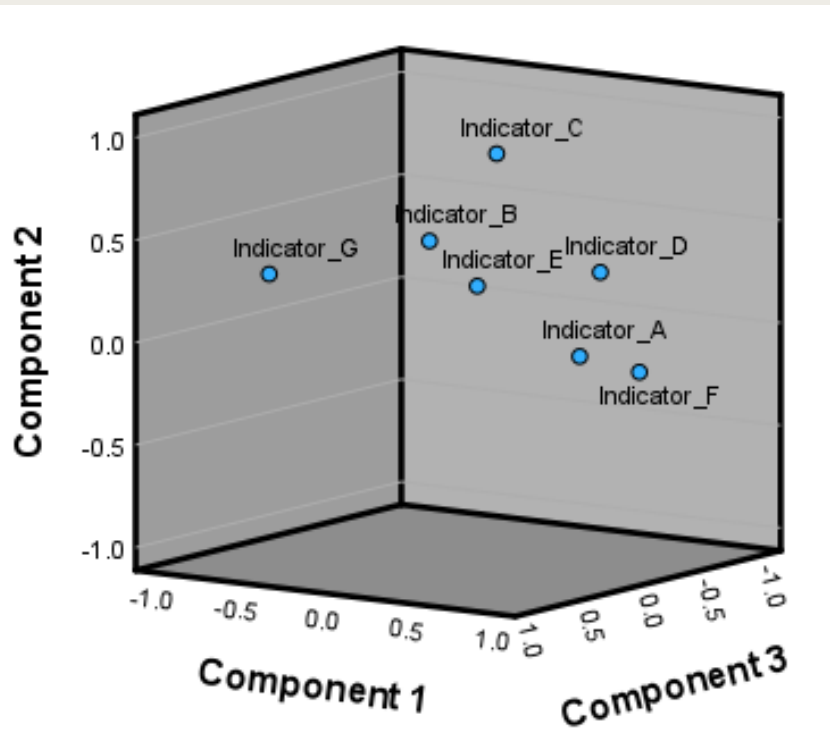


Low positive covariance



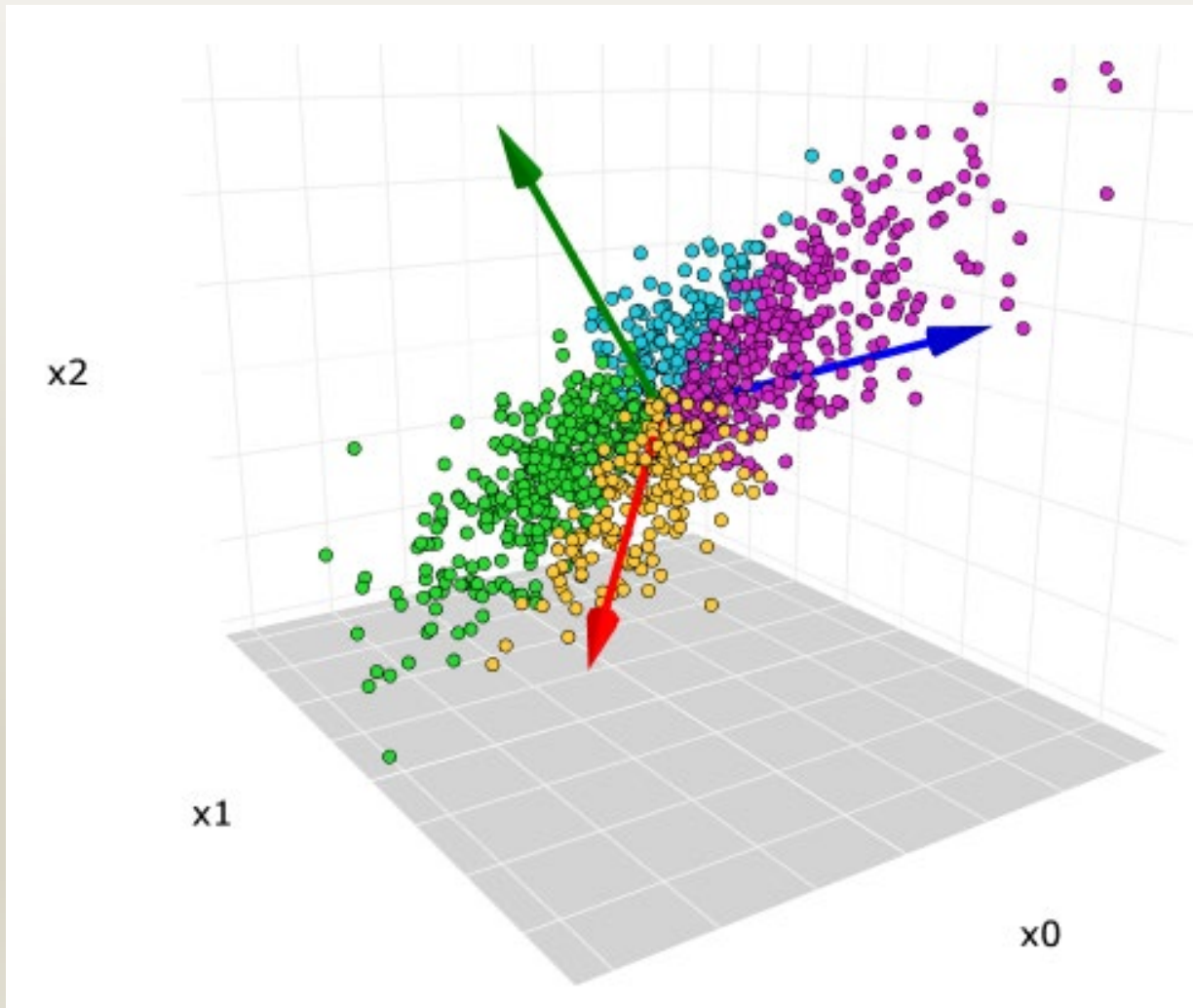
Low negative covariance

DECISION POINT #4 – METHOD EVALUATION



- PCA helps to simplify data by finding new features, called principal components, that capture the most significant patterns in the data. PCA first finds the axis of greatest variation, which is the line of best fit between the data points. This line is called the first principal component. Perpendicular lines of best fit are added to the model to explain the next greatest levels of variance, which make up the subsequent components.
- These principal components are ordered by importance, with the first component explaining the most variance in the data.

DECISION POINT #4 – METHOD EVALUATION



- The 3-dimensional graph shows what data transformed in a PCA model might look like.
- The transformed lines of best fit are called eigenvectors.
- The transformed data points are called eigenvalues.
- Eigenvectors are transformed 3-dimensionally because only 2 perpendicular lines of best fit can exist on a single plain.

DECISION POINT #4 – METHOD EVALUTION

Indicator	Components adjusted by percent of variance							Components summed	Indicator weight
	1	2	3	4	5	6	7		
A	0.092	0.000	0.007	0.004	-0.004	0.003	0.000	0.112	12.9%
B	-0.070	0.017	-0.024	0.020	0.000	0.000	0.000	0.131	15.2%
C	0.013	0.043	-0.008	-0.012	-0.006	0.000	0.000	0.082	9.4%
D	0.090	0.017	-0.008	-0.002	0.012	0.000	0.000	0.130	15.0%
E	0.068	0.019	0.027	0.013	-0.001	-0.002	0.000	0.130	15.0%
F	0.114	-0.007	-0.011	0.005	-0.002	-0.001	0.002	0.141	16.3%
G	-0.097	0.014	0.022	0.002	0.003	0.001	0.001	0.141	16.2%
Percent of Variance	43.0%	17.4%	15.3%	10.9%	7.3%	3.0%	2.0%		

- The table shows an example of a component matrix used to calculate indicator weights for a subdomain.
 - The number of components are determined by the number of indicators.
 - The indicator variances are weighted by the components' percent of explained variance.
 - The weighted variances are aggregated using their sum of squares. Sum of squares are used to scale positive and negative values by their distance from the mean.
 - The subdomain weights are then calculated from their weighted relative variance.

DECISION POINT #4 – RECOMMENDATION



1

The Methodology Workgroup recommends using principal component analysis to weight indicators for the first version of the Oregon Environmental Justice Mapping Tool.



2

The Methodology Workgroup requests flexibility to revisit the recommendation for Decision Point #4 during the sensitivity analysis (Decision Point #8) after the final set of indicators are selected.



3

The Methodology Workgroup also recommends transitioning to participatory weighting of indicators and domains using conjoint analysis for future versions of the Oregon Environmental Justice Mapping Tool. Participatory weighting should include community survey input and technical expert consultation.

DECISION POINT #4 – PCA RATIONALE

Environmental conditions impact health and quality of life unequally and therefore should not be weighted equally.

PCA is a measure of inequity that can tell us which environmental burdens and social disparities are the most inequitable in Oregon.

PCA can also tell us which Oregon communities are experiencing the greatest inequities.

There is an underlying assumption in using PCA for determining weights that the chosen indicators are important, comprehensive components of environmental equity.

DECISION POINT #4 – PCA NARRATIVE

- Let's say unemployment is an important indicator for communities, but all communities in the state are experiencing the exact same level of unemployment. How important would that indicator be for inclusion in equity decision-making?
- Now consider two indicators are important for communities, unemployment and household income. While unemployment has no variation (Variance = 0), household income is much lower in some communities (Variance > 0). Which of these two indicators would be more relevant for equity decision-making?
- From these two premises, we can conclude that variance within an indicator is an important factor in equity decision-making.

DECISION POINT #4 – PCA RATIONALE

- PCA cannot tell us whether being exposed to a particular environmental risk impacts health more than another environmental risk. For example, PCA cannot tell us whether long-term exposure to an air toxic is more harmful than exposure to a drinking water contaminant or whether living in a community with high wildfire risk is worse than living in a community with high flood risk.
- Weighting indicators by their contribution to health or quality of life would require identifying a common outcome for the subdomains and using regression to quantify the associations. We are currently unaware of an outcome that works for all the EJ Mapping Tool subdomains.

DECISION POINT #4 – CONJOINT ANALYSIS RATIONALE

- HB4077 requires Oregon community participation in the development of the Environmental Justice Mapping Tool.
- Conjoint analysis will give us greater opportunities to incorporate community concerns into indicator weighting.
- Unfortunately, the time and resources required for setting up community surveys with equitable demographic and socioeconomic representation and analyzing the data prevent us from using conjoint analysis for the first version of the Oregon Environmental Justice Mapping Tool.
- The EJ Mapping Tool Leadership Team will begin building surveys during development of the first version of the EJ Mapping Tool to collect statewide input from community members for version two of the tool.

ADOPTED DECISION POINT 4

Principal
component
analysis

Conjoint
analysis for
future versions

Domain Aggregation

ENVIRONMENTAL JUSTICE MAPPING
DECISION POINT 5

[OCTOBER 10, 2024 RECORDING LINK](#)

DECISION POINT #5 – DOMAIN AGGREGATION

Key Terms

Cumulative Impacts

- When multiple sources of pollution and other environmental stressors combine over time to cause adverse effects to human health and wellbeing.

Additive Effects

- When the effects of one exposure are independent of other exposures.

Multiplicative Effects

- When the effects of one exposure are associated with other exposures.

Synergistic Effects

- When combined impacts are greater than the sum of individual impacts.

DECISION POINT #5 – DOMAIN AGGREGATION Additive Model

CDC Environmental Justice Index -

additive models allow for a greater influence of individual modules on the overall model. In the case of the EJI, this means that a community that experiences high levels of social vulnerability and environmental burden could receive a high overall EJI score, even if it does not score high for health vulnerability. This feature may be seen as a strength or a weakness of the model, something which has been a topic of debate in states which have implemented a multiplicative model.

DECISION POINT #5 – DOMAIN AGGREGATION Multiplicative Model

CalEnviroScreen:

Existing research on environmental pollutants and health risk has consistently identified socioeconomic and sensitivity factors as “effect modifiers” that multiply the risks posed by the pollutants.

Some people (such as children) may be 10 times more sensitive to some chemical exposures than others. Risk assessments apply numerical factors or multipliers to account for potential human sensitivity in deriving acceptable exposure levels (US EPA, 2012).

Priority rankings done by various emergency response organizations to score threats have used scoring systems with the formula:

$$\text{Risk} = \text{Threat} \times \text{Vulnerability (Brody et al., 2012)}.$$

DECISION POINT #5 – DOMAIN AGGREGATION



Additive Equation

*(Environmental Exposures
+ Environmental Hazards +
Climate Change Risks +
Built Environment +
Human Health + Social
Factors)/6 = EJ Index Score*



Multiplicative Equation

*(Environmental Exposures
+ Environmental Hazards +
Climate Change Risks +
Built Environment)/4 x
(Human Health + Social
Factors)/2 = EJ Index Score*

DECISION POINT #5 – DOMAIN AGGREGATION

In this hypothetical example, all subdomain scores are equal, but the combined multiplicative score is higher than the additive score.

Additive Equation

$$(0.3 (EE) + 0.3 (EH) + 0.3 (CCR) + 0.3 (BE) + 0.3 (HH) + 0.3 (SF))/6 = 0.3$$

Multiplicative Equation

$$(0.3 (EE) + 0.3 (EH) + 0.3 (CCR) + 0.3 (BE))/4 \times (0.3 (HH) + 0.3 (SF))/2 = 0.7$$

DECISION POINT #5 – DOMAIN AGGREGATION

When an environmental burden (Place) subdomain score is increased, the multiplicative index score increases more than the additive index score

Additive Equation

$$(0.6)(EE) + 0.3(EH) + 0.3(CCR) + 0.3(BE) + 0.3(HH) + 0.3(SF))/6 = 0.4$$

Multiplicative Equation

$$(0.6)(EE) + 0.3(EH) + 0.3(CCR) + 0.3(BE))/4 \times (0.3(HH) + 0.3(SF))/2 = 0.9$$

DECISION POINT #5 – DOMAIN AGGREGATION

When a disadvantaged community (People) subdomain score is increased, the increase in the multiplicative score compared to the increase in the additive score is even more pronounced because there are fewer subdomains in the People domain.

Additive Equation

$$(0.3 (EE) + 0.3 (EH) + 0.3 (CCR) + 0.3 (BE) + \textcolor{red}{0.6} (HH) + 0.3 (SF)) / 6 = \textcolor{red}{0.4}$$

Multiplicative Equation

$$(0.3 (EE) + 0.3 (EH) + 0.3 (CCR) + 0.3 (BE)) / 4 \times (\textcolor{red}{0.6} (HH) + 0.3 (SF)) / 2 = \textcolor{red}{1.1} \uparrow$$

DECISION POINT #5 – RECOMMENDATION

The Methodology Workgroup recommends using **CalEnviroScreen** 's multiplicative approach to domain aggregation where the subdomains are summed, but the primary domains (Place & People) are multiplied.

$$(Environmental\ Exposures + Environmental\ Hazards + Climate\ Change\ Risks + Built\ Environment)/4 \times (Human\ Health + Social\ Factors)/2 = EJ\ Index\ Score$$

DECISION POINT #5 – RATIONALE

- Cumulative impacts are not independent. Health effects caused by environmental exposures are multiplicative in vulnerable populations (McHale et al., 2017).
- Evidence from human studies have shown that population characteristics can modify the response to pollution burden multiplicatively, providing scientific support for the use of a multiplier (Alexeeff et al., 2012).
- Priority rankings done by various emergency response organizations to score threats have used scoring systems with the formula:
Risk = Threat × Vulnerability (Brody et al., 2012).
- Applying additive aggregation to subdomains will provide more insight into the interactions of the indicators (VanderWeele & Knol, 2014).

ADOPTED DECISION POINT 5

Multiplicative Approach

- ***(Environmental Exposures + Environmental Hazards + Climate Change Risks + Built Environment)/4 x (Human Health + Social Factors)/2 = EJ Index Score***



Data Standardization

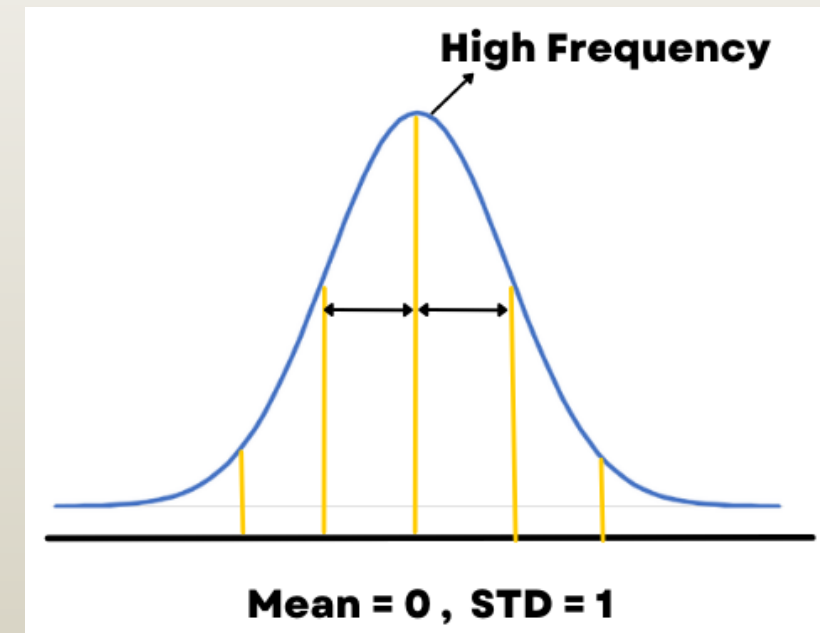
ENVIRONMENTAL JUSTICE MAPPING
DECISION POINT 6

[OCTOBER 10, 2024 RECORDING LINK](#)

DECISION POINT #6 – DATA STANDARDIZATION

Introduction to Data Standardization

Raw indicator data units can differ a lot and are often incompatible for aggregation inside a composite index. For example, it would not make sense to combine median income in census tracts with percent of population living with a disability because one value is monetary and the other is a percentage. Therefore, it is necessary to normalize the data by converting it to quantiles like percentiles or z-scores.



DECISION POINT #6 – DATA STANDARDIZATION

Key Terms:

Quantile - values that split sorted data into equal parts. Common quantiles are quartiles (four groups), deciles (ten groups), and percentiles (100 groups).

Percentile - quantiles obtained by adopting a subdivision into 100 groups. The n th percentile of a set of data is the value at which n percent of the data is below it. For example, a percentile score of 25 means that 25% of the other scores are lower. A high percentile means the value is relatively uncommon.

Z-score – the distance and direction of an observation away from the population mean. If a z-score is equal to 0, it is on the mean. A positive z-score indicates the raw score is higher than the mean average. For example, if a z-score is equal to +1, it is 1 standard deviation above the mean.

DECISION POINT #6 – RECOMMENDATION

The Methodology Workgroup recommends:

- Standardizing raw indicator values using z-scores.
- Reducing the effects of extreme outliers in the data.
- Using a process called "winsorization" to reduce outliers and rescale the z-scores.
- Rescaling winsorized z-scores between 1-99 percent for easier interpretation.
- For future versions of the Oregon EJ Mapping Tool, explore the feasibility of identifying optimal indicator scores and scale the data by distance from the optimal score or reference point.

DECISION POINT #6 – RATIONALE

- A percentile does not describe the magnitude of the difference between two or more communities. For example, a community ranked in the 30th percentile is not necessarily three times more impacted than a community ranked in the 10th percentile.
- Investments in communities should be made where risks are the worst. Z-scores are more accurate than percentiles at identifying outliers and similarities between communities. Indicators with extreme values thus have a greater effect on the composite index.
- It may be necessary to cap high and low z-scores to avoid skewing the mean indicator scores.
- The Methodology Workgroup endorses further exploration of setting reference points for indicators because it can show whether a goal is achieved for a community or how far it is away from reaching a goal.

ADOPTED DECISION POINT 6

- Standardizing raw indicator values using z-scores.
- Reducing the effects of extreme outliers in the data.
- Using a process called "winsorization" to reduce outliers and rescale the z-scores.
- Rescaling winsorized z-scores between 1-99 percent for easier interpretation.
- For future versions of the Oregon EJ Mapping Tool, explore the feasibility of identifying optimal indicator scores and scale the data by distance from the optimal score or reference point.

Indicator Selection Inclusion Criteria

ENVIRONMENTAL JUSTICE MAPPING
DECISION POINT 7

[DECEMBER 12, 2024 RECORDING LINK](#)

DECISION POINT #7 – INDICATOR SELECTION

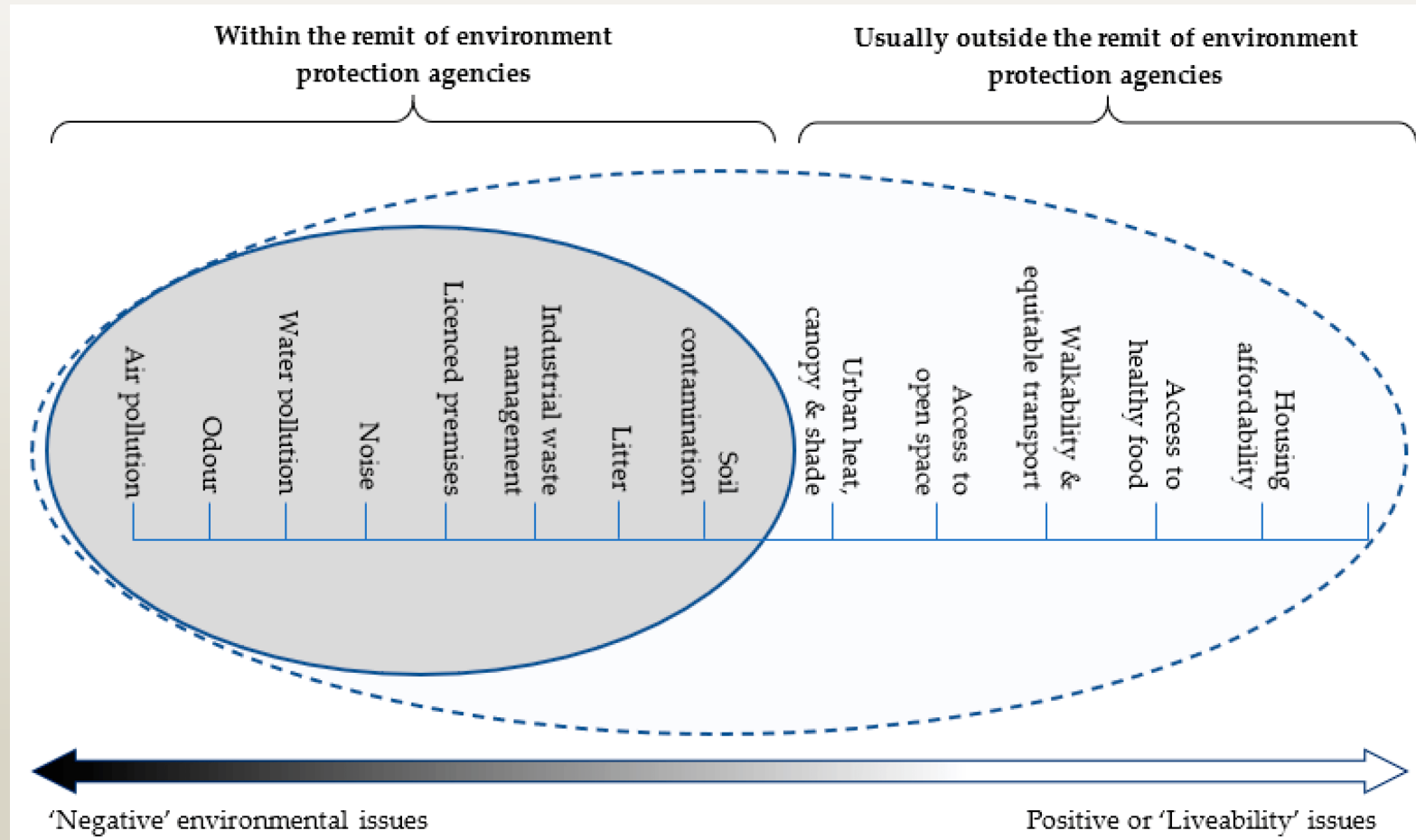
Introduction Continued

10(4) “Environmental justice community” includes communities of color, communities experiencing lower incomes, communities experiencing health inequities, tribal communities, rural communities, remote communities, coastal communities, communities with limited infrastructure and other communities traditionally underrepresented in public processes and adversely harmed by environmental and health hazards, including seniors, youth and persons with disabilities.

12(3) The mapping tool must:

- (a) Be based on factors that are derived from direct input through the inclusive community engagement process described in subsection (2) of this section;
- (b) Be sufficiently detailed to allow the assessment of environmental justice benefits and burdens;

DECISION POINT #7 – INDICATOR SELECTION



Browne, G.R.; Gunn, L.D.; Davern, M. [A Framework for Developing Environmental Justice Indicators](#). *Standards* 2022, 2, 90-10.

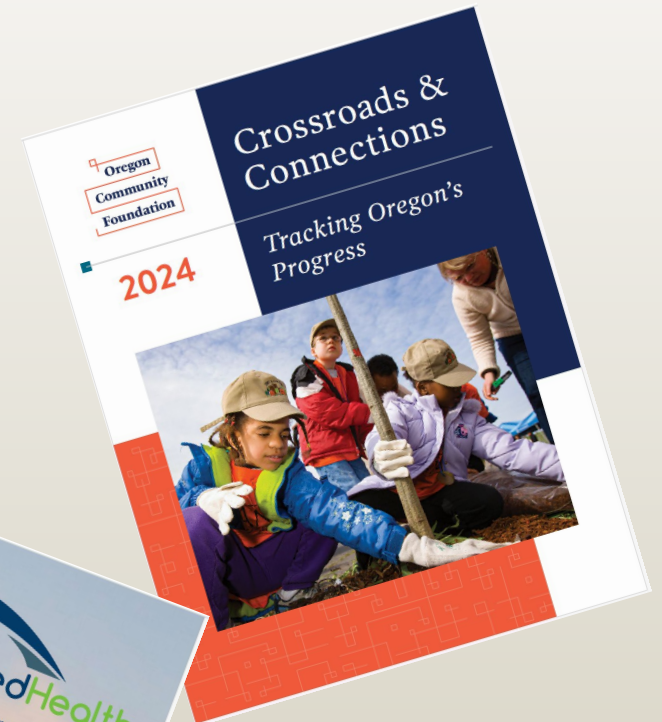
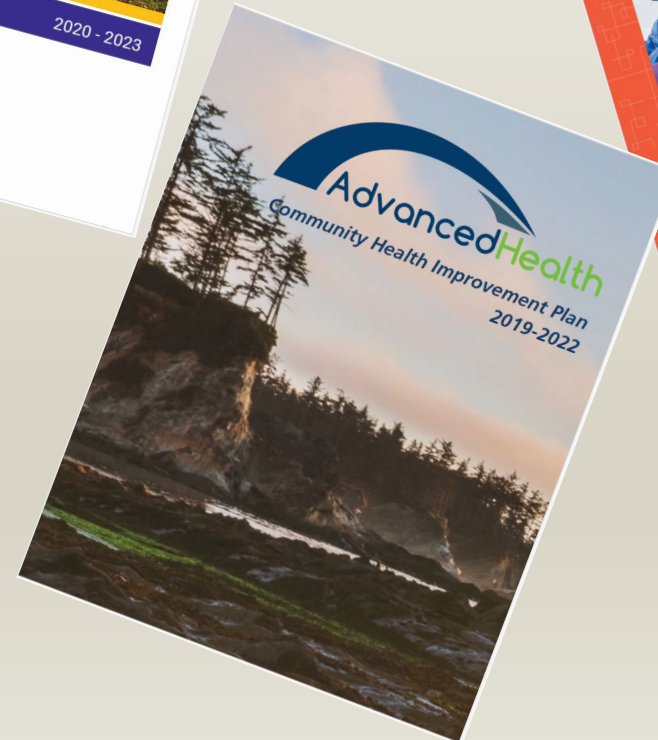
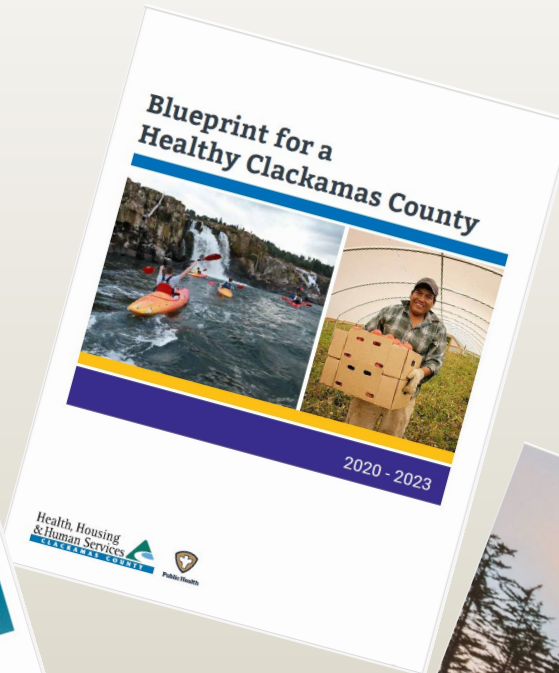
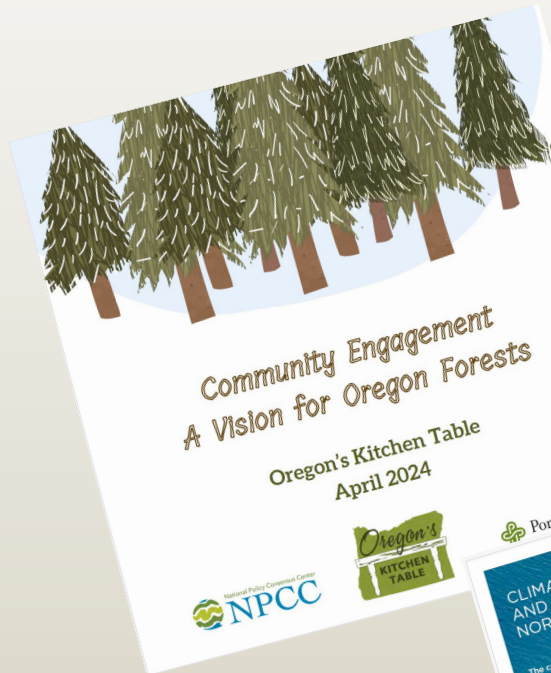
DECISION POINT #7 – INDICATOR SELECTION Inclusion Criteria P1

Criteria for Indicator Selection	HB4077 Subsection
Indicators should provide a measure that is relevant to the subdomain it represents, in the context of “Environmental Burden”, “Environmental Justice”, and “Environmental Justice Community” definitions in HB4077.	• 11(2) • 11(3) • 11(4)
Indicators should represent community concerns related to pollution burden, climate change risks, environmental conditions, human health, or social factors.	• 12(A)
Community input and feedback should be considered. Indicators proposed and accepted during the community engagement process should be prioritized.	• 12(2)
Indicators should be linkable to policy and other actions with measurable goals for reducing environmental disparities across Oregon.	• 13(1)(d)
The mapping tool should include data from Oregon natural resources agencies or data compatible with environmental justice mapping tools developed by other state agencies.	• 12(3)(d)

DECISION POINT #7 – INDICATOR SELECTION Inclusion Criteria P2

Criteria for Indicator Selection	HB4077 Subsection
If a health-related measure, the health outcome should be associated with environmental exposures or known to be exacerbated by environmental conditions.	High priority
The presence or absence of the environmental characteristics represented by the indicator should have a quantifiable negative effect on human health.	High priority
Data for each indicator should be available for the entire state or community designation at the census tract level or be translatable to the census tract level.	High priority
Data should be of sufficient quality and be: a) Complete b) Current c) Accurate	12(3)(b) 12(4)
Data should be accessible to the public.	12(3)(e)
The office of Enterprise Information Services shall recommend data quality standards.	12(4)

DECISION POINT #7 – OTHER COMMUNITY INPUT



DECISION POINT #7 – COMMUNITY REPORTS

Report Title	Vision for Oregon Forests - Community Engagement Report
Agency/CBO	Oregon's Kitchen Table & Board of Forestry
Citation	Oregon's Kitchen Table. Vision for Oregon Forests: Community Engagement Report. April 2024.
Year	2024
Communities	Cornelius, Grants Pass, Madras, Communities in all counties
Community Designation	Remote/Rural/Statewide
Topic	Board of Forestry and Oregon Department of Forestry new strategic plan
Project Goals	Hear from people throughout Oregon about what connects them to Oregon forests ...
Meeting Period	June 2023 - October 2023
Exposure and Risk Indicators Discussed	Access to recreation, wildfire risk, wildfire Smoke, impaired waterbodies, etc.
Health and Social Factor Indicators Discussed	Employment, public safety, etc.
Burden or Benefit	Both
Lived Experiences/Community Quotes	"As a woman, it's unsafe to travel alone in the forest..."
EJ Relevance (Low, Med, High)	High
Is Data Actionable (Y/N)	Yes
Is Data Available (Y/N)	Yes

ADOPTED DECISION POINT 7 – INDICATOR Inclusion Criteria P1

Criteria for Indicator Selection	HB4077 Subsection
Indicators should provide a measure that is relevant to the subdomain it represents, in the context of “Environmental Burden”, “Environmental Justice”, and “Environmental Justice Community” definitions in HB4077.	• 11(2) • 11(3) • 11(4)
Indicators should represent community concerns related to pollution burden, climate change risks, environmental conditions, human health, or social factors.	• 12(A)
Community input and feedback should be considered. Indicators proposed and accepted during the community engagement process should be prioritized.	• 12(2)
Indicators should be linkable to policy and other actions with measurable goals for reducing environmental disparities across Oregon.	• 13(1)(d)
The mapping tool should include data from Oregon natural resources agencies or data compatible with environmental justice mapping tools developed by other state agencies.	• 12(3)(d)

ADOPTED DECISION POINT 7 – INDICATOR Inclusion Criteria P2

Criteria for Indicator Selection	HB4077 Subsection
If a health-related measure, the health outcome should be associated with environmental exposures or known to be exacerbated by environmental conditions.	• High priority
The presence or absence of the environmental characteristics represented by the indicator should have a quantifiable negative effect on human health.	• High priority
Data for each indicator should be available for the entire state or community designation at the census tract level or be translatable to the census tract level.	• High priority
Data should be of sufficient quality and be: a) Complete b) Current c) Accurate	• 12(3)(b) • 12(4)
Data should be accessible to the public.	• 12(3)(e)
The office of Enterprise Information Services shall recommend data quality standards.	• 12(4)