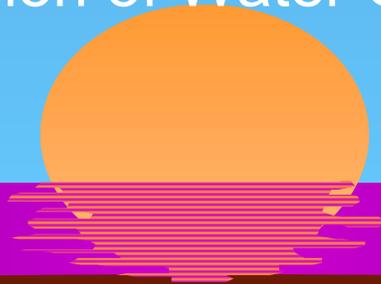


Watershed Assessment

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What Is Watershed Monitoring?

Measuring or observing watershed features to:

- 👉 assess ecosystem health and human use
- 👉 detect early warnings of change
- 👉 tell us whether we've achieved our management goals
- 👉 provide insight into the causes of problems



The Watershed Assessment Process

- ① Inventory/research what's Known: where are the gaps?
- ② What are your watershed management goals?
- ③ Identify benchmarks of success
- ④ Design the assessment
- ⑤ Monitor/gather data
- ⑥ Turn data into information / model
- ⑦ Get the information out in ways people understand
- ⑧ Turn info to action or refine assessment
- ⑨ Continue monitoring to assess progress



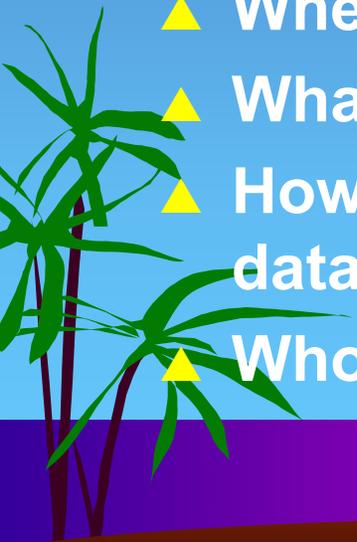
Watershed Assessment Basic Concepts

- ① Watershed stress-exposure-response
- ② You will never have all the info you need
- ③ Tailor your assessment to your needs and capabilities
- ④ Be sure to measure response Indicators: living communities
- ⑤ Inventory vs. modeling
- ⑥ Make choices through a logical process . . .



Watershed Assessment Design

- ▲ Ask a specific question
- ▲ What will you monitor?
- ▲ What are your data quality goals?
- ▲ How will you monitor?
- ▲ Where will you monitor?
- ▲ When will you monitor?
- ▲ What are your quality assurance measures?
- ▲ How will you manage, analyze and report the data?
- ▲ Who will do what?



Ask A Specific Question . . .

. . . And design the assessment to answer that question

- ▲ Is the river system or lake supporting its uses and values?
- ▲ What are the impacts of human alterations of the river system or lake on human use and ecological integrity?
- ▲ How effective are site specific and watershed-wide water and land management strategies in restoring and protecting human use and ecological integrity?
- ▲ Are conditions changing?



What Will You Monitor?

▲ Types of indicators

- stress indicators
- exposure indicators
- response indicators

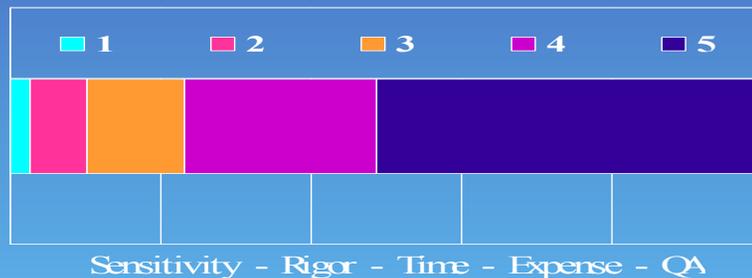
▲ Considerations in selecting indicators

- Scientific
- Practical



What Are Your Data Quality Goals?

- ▲ How good does your information need to be to be useful (to whom and for what)?
- ▲ Data quality continuum



1. Education and Awareness
2. Gross Problem Screening
3. Community and Watershed Assessment
4. Federal & State Assessment
5. Legal / Regulatory

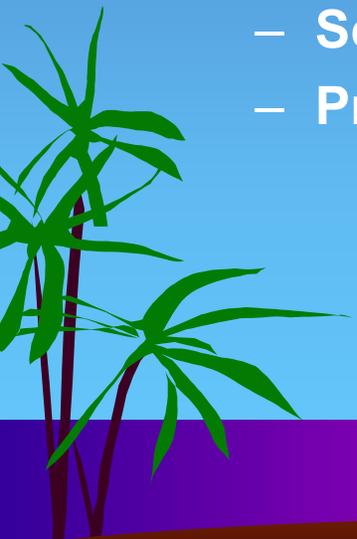
How Will You Monitor?

▲ Types of methods

- water and aquatic life
- channels
- shorelines and riparian areas
- human users and uses

▲ Considerations in selecting methods

- Scientific
- Practical



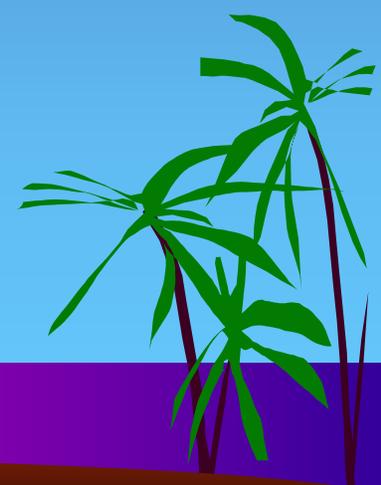
Where Will You Monitor?

▲ Types of sites

- watershed reference
- pollution source control, impact and recovery
- aquatic life habitat (fish and benthic macroinvertebrates)
- water use
- tributary impacts: reference, impact, recovery, integrator
- pollution sources
- public health

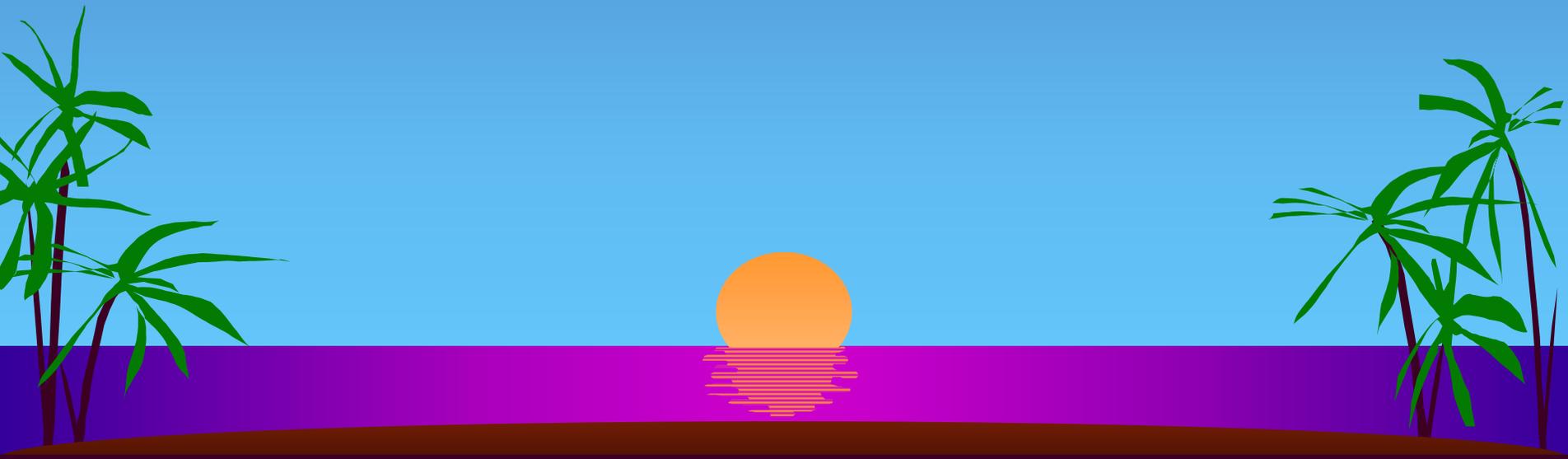
▲ Considerations in selecting sites

- general
- site specific (depth and transect)



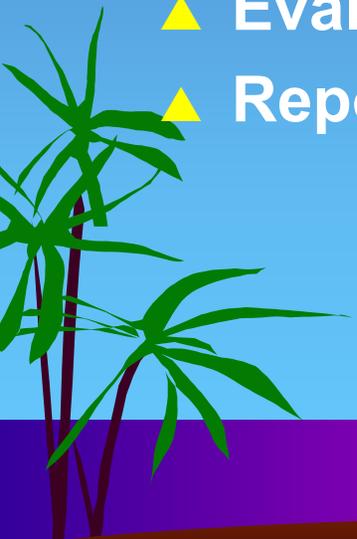
When Will You Monitor?

- ▲ Time of Year
- ▲ Time of Day
- ▲ Frequency
- ▲ Weather



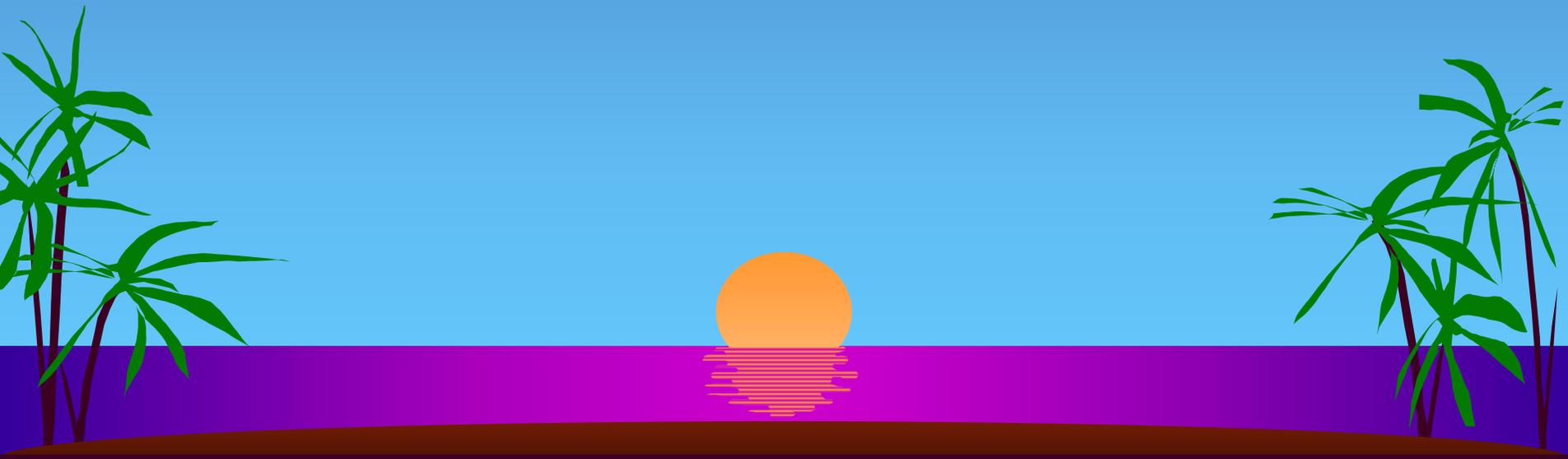
What Are Your Quality Assurance Measures?

- ▲ Organization and planning
- ▲ Sampling and analysis facilities
- ▲ Quality control
- ▲ Data management
- ▲ Documentation
- ▲ Evaluation and response
- ▲ Reporting



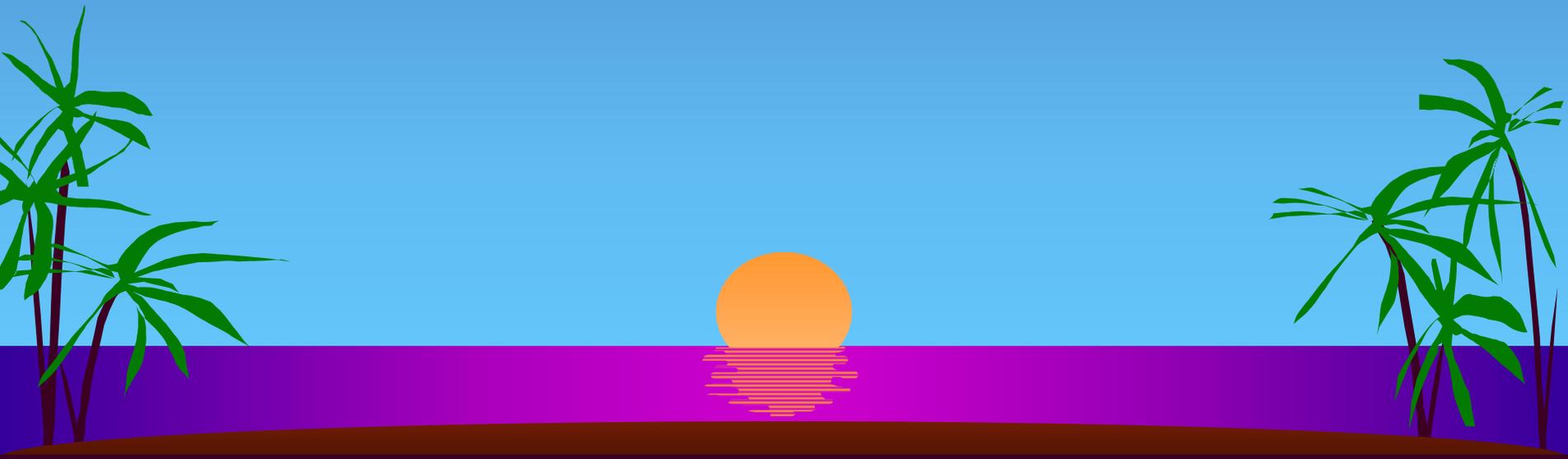
How Will You Manage, Analyze And Report The Data?

- ▲ Data management
- ▲ Data summary
- ▲ Data interpretation / modeling
- ▲ Reporting



Who Will Do What?

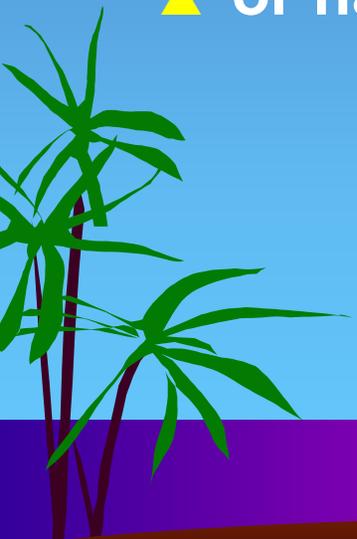
- ▲ **Coordination**
- ▲ **Monitoring tasks**



What Are Indicators?

Measurable features that provide evidence of

- ▲ the magnitude of stress
- ▲ or the degree of exposure to stress
- ▲ or the degree of ecological response to the exposure
- ▲ or habitat quality



Watershed Indicators

Types of Indicators

▲ Early Warning

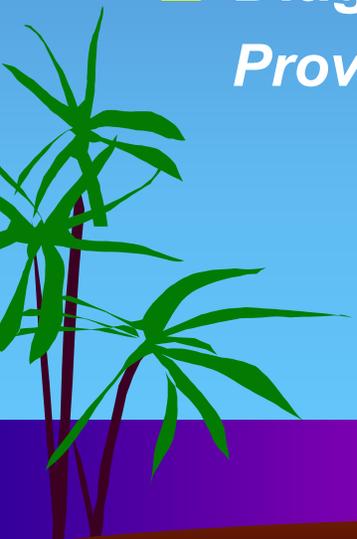
Detect early signs of ecosystem change

▲ Compliance

Tell us whether we've achieved our ecosystem management objectives

▲ Diagnostic

Provide insight into the causes of problems



Management Objectives

Human Health
and Aesthetics

Ecological
Condition

Economic
Uses

**Fish, Wildlife
Consumption**

**Water Supply
and Food
Processing**

**Recreation:
Water Contact**

**Recreation:
Fishing**

Aquatic Life

Hydropower

Industrial

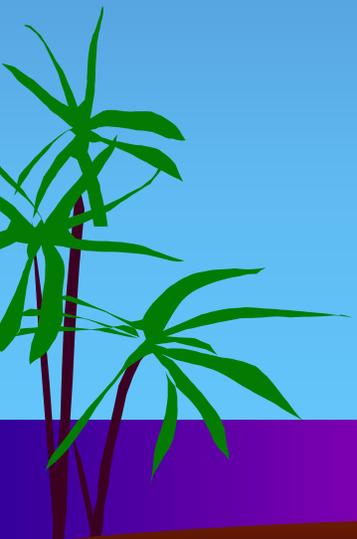
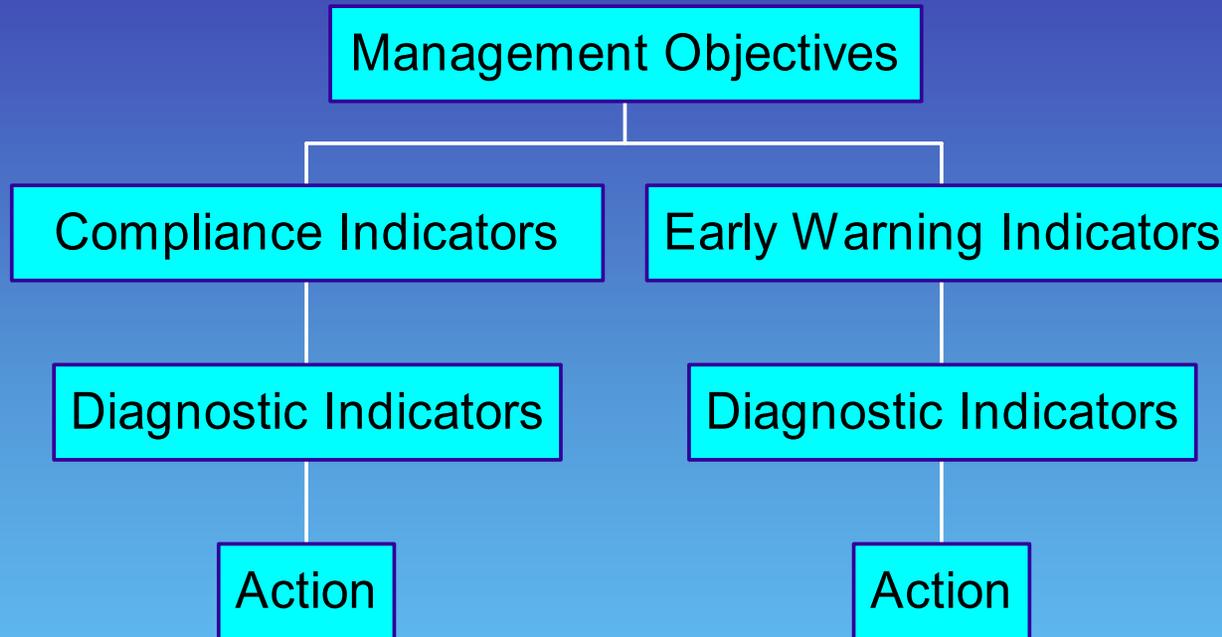
Forestry

Agriculture

Transportation



How Indicators Are Used



Watershed Indicators

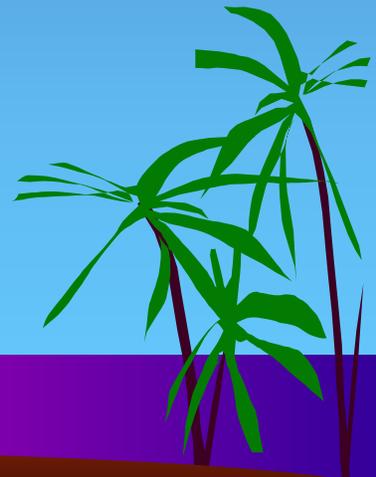
Categories of Indicators

- ▲ Biological
- ▲ Chemical
- ▲ Physical
- ▲ Watershed-Level Stress
- ▲ Ecosystem Integrity
- ▲ Public Health
- ▲ Human Land and Water Use
- ▲ Economic (affected by ecological condition)



Biological Indicators (response & exposure)

- ▲ Macroinvertebrates
- ▲ Fish
- ▲ Wildlife (aquatic, riparian, terrestrial, avian)
- ▲ Pathogens and Fecal Indicator Bacteria
- ▲ Plankton (phytoplankton & zooplankton)
- ▲ Periphyton
- ▲ Aquatic and Semi-Aquatic Macrophytes
- ▲ Habitat Characteristics



Chemical Indicators

(response & exposure)

▲ Dissolved Gases

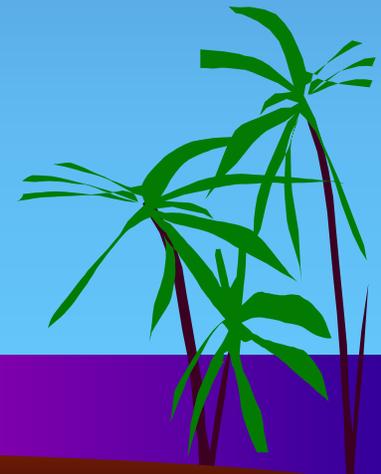
- Oxygen
- Carbon Dioxide

▲ Major Ions

- pH
- alkalinity
- Conductivity / dissolved solids

▲ Nutrients

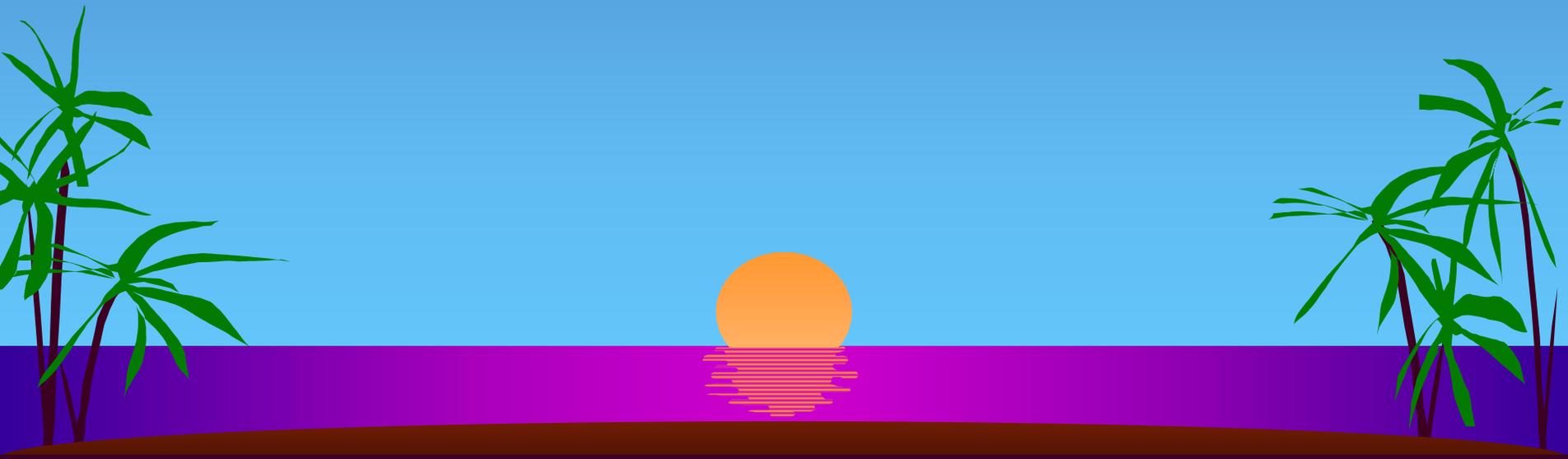
- Nitrogen
- Phosphorus



Chemical Indicators

(response & exposure)

- ▲ **Odor & Taste**
- ▲ **Potentially Hazardous Chemicals (in the water)**
- ▲ **Potentially Hazardous Chemicals (on the bottom or attached to sediment)**



Physical Indicators (response & exposure)

Water Column and Channel

- ▲ Water Quantity
- ▲ Water Temperature
- ▲ Water Clarity
- ▲ Suspended Sediment
- ▲ Bed Sediment & Bottom Characteristics
- ▲ Geomorphology (Channel Characteristics)
- ▲ Habitat (Type and Distribution)



Physical Indicators (response & exposure)

Riparian and Wetland

- ▲ Riparian or Shoreline Characteristics
- ▲ Habitat (types, fragmentation, linkages)
- ▲ Groundwater (springs and seeps)
- ▲ Land (geology, soils, topography)
- ▲ Vegetation (type and diversity)



Watershed Level Stress Indicators

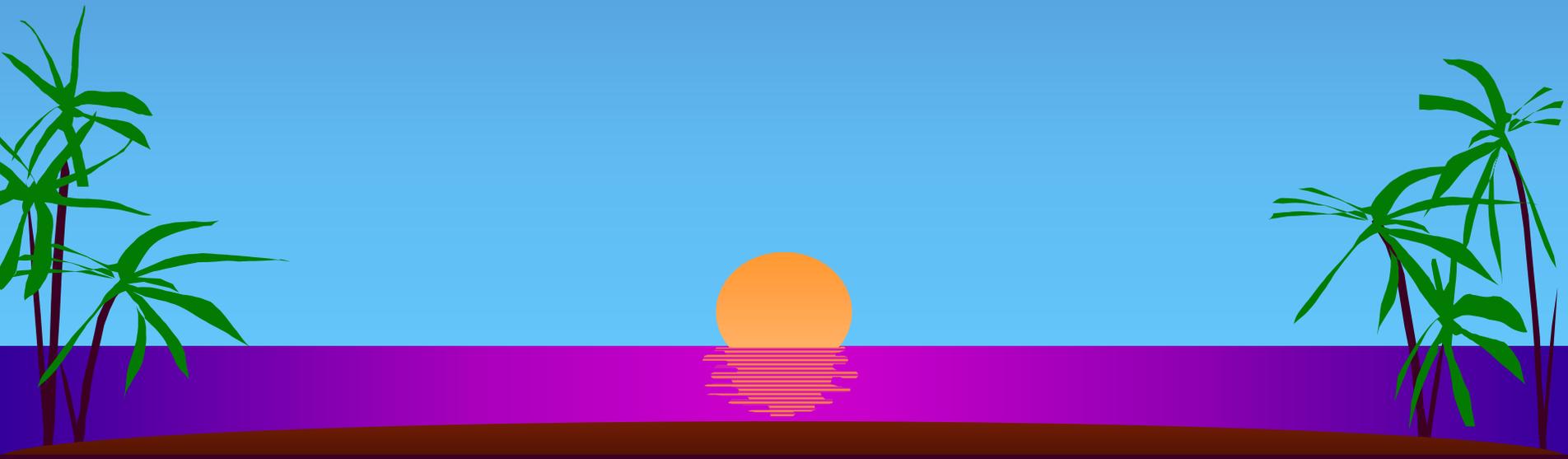
Land Use Type and Intensity

- ▲ Land cover and vegetation
- ▲ Application of chemicals and wastes
- ▲ Air borne contaminates
- ▲ Assimilative capacity
- ▲ Channel or flow modifications
- ▲ Ecoregional Characteristics



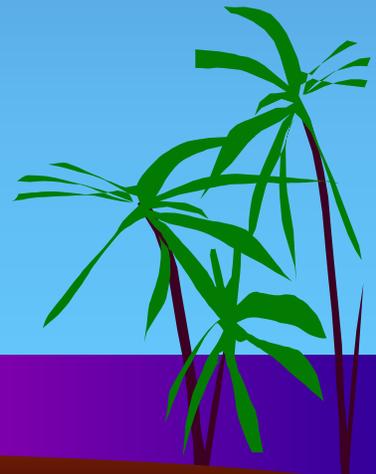
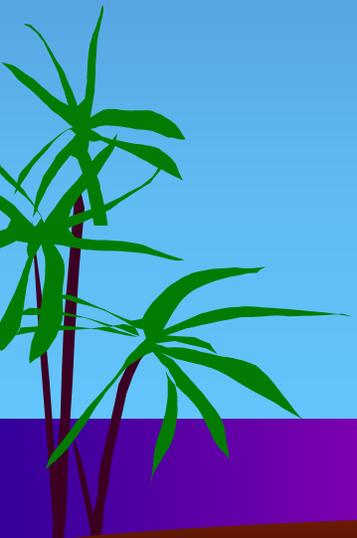
Ecosystem Integrity Indicators

- ▲ Habitat Quality
- ▲ Aquatic Life Use Support
- ▲ Indices of Biotic Integrity
- ▲ Species at Risk
- ▲ Wetland Acreage



Public Health Indicators

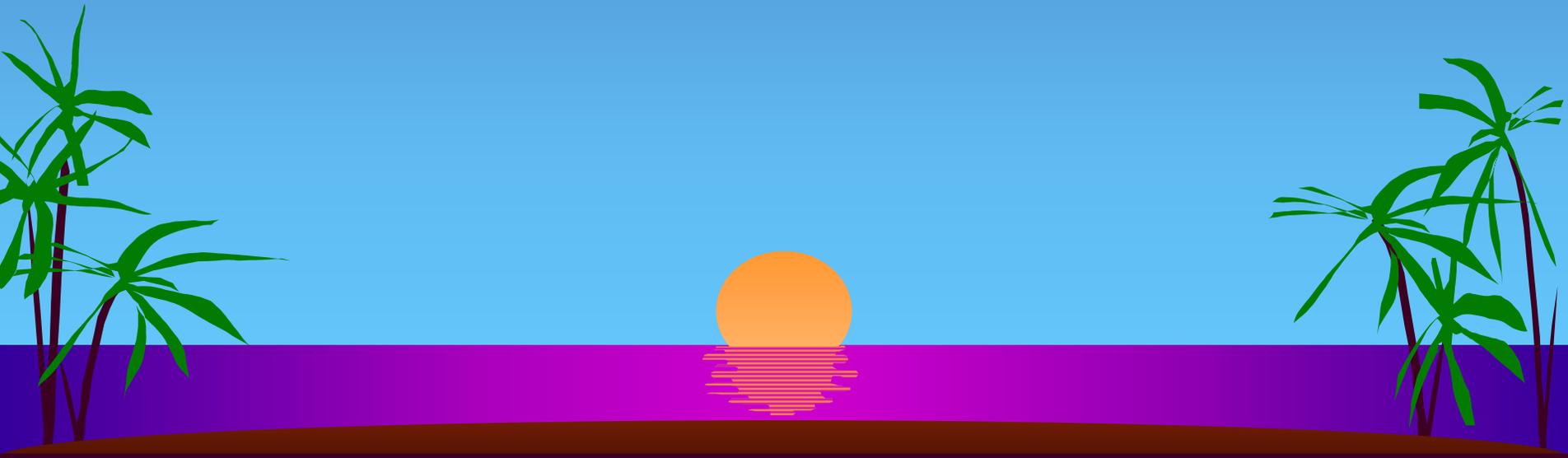
- ▲ Occurrence of Disease
- ▲ Exposure to Disease-causing Agents
- ▲ Failing or at risk drinking water systems
- ▲ Protected water sources
- ▲ Fish consumption advisories



Economic Indicators

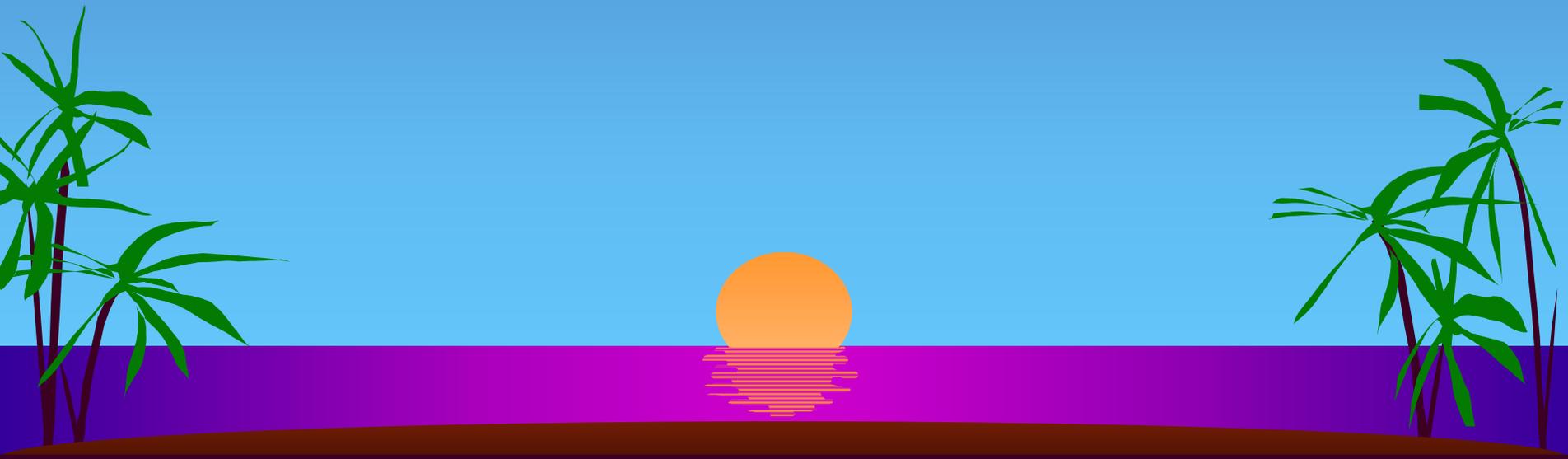
Affected by Ecological Conditions

- ▲ Property Values
- ▲ Fish Harvest Levels
- ▲ Impacts of Nuisance Plant and Animal Species
- ▲ Reservoir Capacity



Human Use Indicators

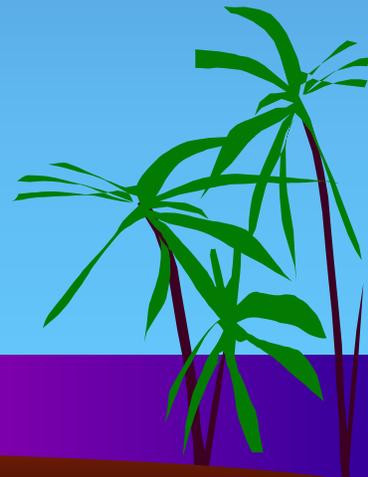
- ▲ Drinking Water uses Supported
- ▲ Fish Consumption Supported
- ▲ Recreation Use Supported
- ▲ Total Water Consumption
- ▲ Land Use Patterns



Considerations for Selecting Indicators

Scientific

- ▲ Does it help you answer your question?
- ▲ Can you measure or quantify it?
- ▲ Does it respond over a reasonable time period?
- ▲ Does it respond to the impacts you're evaluating?
- ▲ Can you isolate the conditions that cause it to change?



Considerations for Selecting Indicators

Scientific (continued)

- ▲ Does it integrate effects over time and space?
- ▲ Does it respond to changes in other indicators?
- ▲ Is it a true measure of the condition you're assessing?
- ▲ Is there a reference condition?
- ▲ Does it provide early warning of changes?



Considerations for Selecting Indicators

Practical / Programmatic

- ▲ Do you have the resources to measure it?
- ▲ How difficult is it to measure?
- ▲ Does it help you understand a major part of the ecosystem?
- ▲ Is it explainable to your target audience?



Types of Monitoring Methods

Water and Aquatic

- ▲ Sampling and Analysis
- ▲ Direct Field Measurements
- ▲ Visual Surveys
- ▲ Remote Sensing
- ▲ Habitat Assessments



Types of Monitoring Methods

Channels

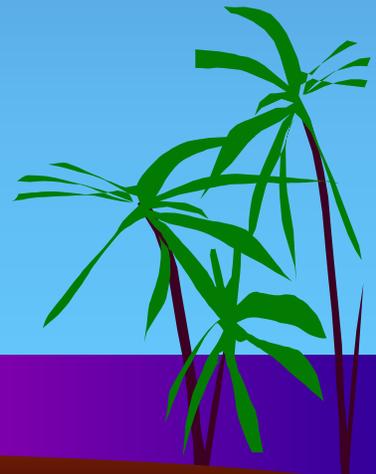
- ▲ Direct Field Measurements
- ▲ Visual Surveys
- ▲ Sediment Sampling and Analysis
- ▲ Field Inventories
- ▲ Remote Sensing
- ▲ Habitat Assessments



Types of Monitoring Methods

Shorelines and Riparian Areas

- ▲ Field Inventories (land use, resources, wildlife)
- ▲ Site Assessments
- ▲ Sediment Sampling and Analysis
- ▲ Visual Surveys
- ▲ Remote Sensing (land cover, use, etc.)
- ▲ Habitat Assessments



Types of Monitoring Methods

Human Users and Uses

- ▲ Epidemiological Surveys
- ▲ User Surveys
- ▲ Perception Surveys
- ▲ Discharge Permit Compliance
- ▲ Water Supply System Compliance
- ▲ Sanitary Surveys



Considerations for Selecting Methods

Scientific

- ▲ Does it meet your data quality requirements?
 - Accuracy
 - Precision
 - Range and Sensitivity
- ▲ Does it yield representative samples?
- ▲ What lab facilities and equipment are required?
- ▲ Is it comparable to methods used by agencies collecting similar information?



Considerations for Selecting Methods

Practical / Programmatic

- ▲ Do you have the resources?
 - How difficult is it?
 - How time-consuming is it?
 - How expensive is it?
- ▲ Will it produce data useful to your target audience?

