Environmental Public Health

Office of Environmental Health

Leadership for a Healthy Arizona

Arizona Department of Health Services

Outline

- Environmental Public Health
- Relationship between agencies
- Public Health Assessments & Health Consultations
  - Exposure Pathways & Toxicity
  - Exposure Assessment & Conclusions
- Health Effects from TCE & TCE degradation products
- Case Study

Public Health

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What is Public Health?

- Population based approach to healthy living
- Purpose of Public Health:
  - Prevent epidemics and the spread of disease
  - Protect against environmental hazards
  - Prevent injuries
  - Promote and encourages healthy behaviors
  - Respond to disasters and assists communities in recovery
  - Assure the quality and accessibility of health services
- Different from individual care (medicine)

History of Public Health

- Dark Ages
  - Sewers, piped water, bathing facilities
  - Quarantine
  - Hygiene, diet, exercise
- 1662
  - 1st death registry to include cause of death
- John Snow, 1849
  - Mapped out cholera cases
  - More cases near the Broad Street water pump, water came from the Thames River downstream sewage contamination
  - Removed the pump's handle – public health intervention

Essential Services of Public Health

- Monitor health status to identify and solve community health problems
- Diagnose and investigate health problems and health hazards in the community
- Inform, educate, and empower people about health issues
- Mobilize community partnerships to identify and solve health issues
- Develop policies and plans that support health and ensure safety

Essential Services of Public Health

- Enforce laws and regulations that protect health and ensure safety
- Link people to needed personal health services
- Assure a competent public and personal health care workforce
- Evaluate effectiveness, accessibility, and quality of personal and population-based health services
- Research for new insights and innovate solutions to health problems

Federal Public Health Agencies

- U.S. Department of Health and Human Services (HHS)
  - ATSDR - Agency for Toxic Substances & Disease
  - CDC - Centers for Disease Control & Prevention
  - NIH - National Institutes of Health
  - OS - Office of the Secretary
  - ACF - Administration for Children & Families
  - AoA - Administration on Aging
  - AHRQ - Agency for Healthcare Research & Quality
  - CMS - Centers for Medicare & Medicaid Services
  - FDA - Food & Drug Administration
  - HRSA - Health Resources & Services Administration
  - SAMHSA - Substance Abuse & Mental Health Services Administration
  - IHS - Indian Health Service
  - OIG - Office of Inspector General

Federal Public Health Agencies (cont.)

- Environmental Protection Agency (EPA)
- Office of Public Health and Science
- Office of the Surgeon General
- Consumer Product Safety Commission
- Department of Agriculture
- Department of Defense
- Department of Veterans Affairs (VA)
- Occupational Safety and Health Administration (OSHA)
- Office of Personnel Management
- Employee Health Programs
- Federal Employee Health Benefit Program
- Social Security Administration (SSA)

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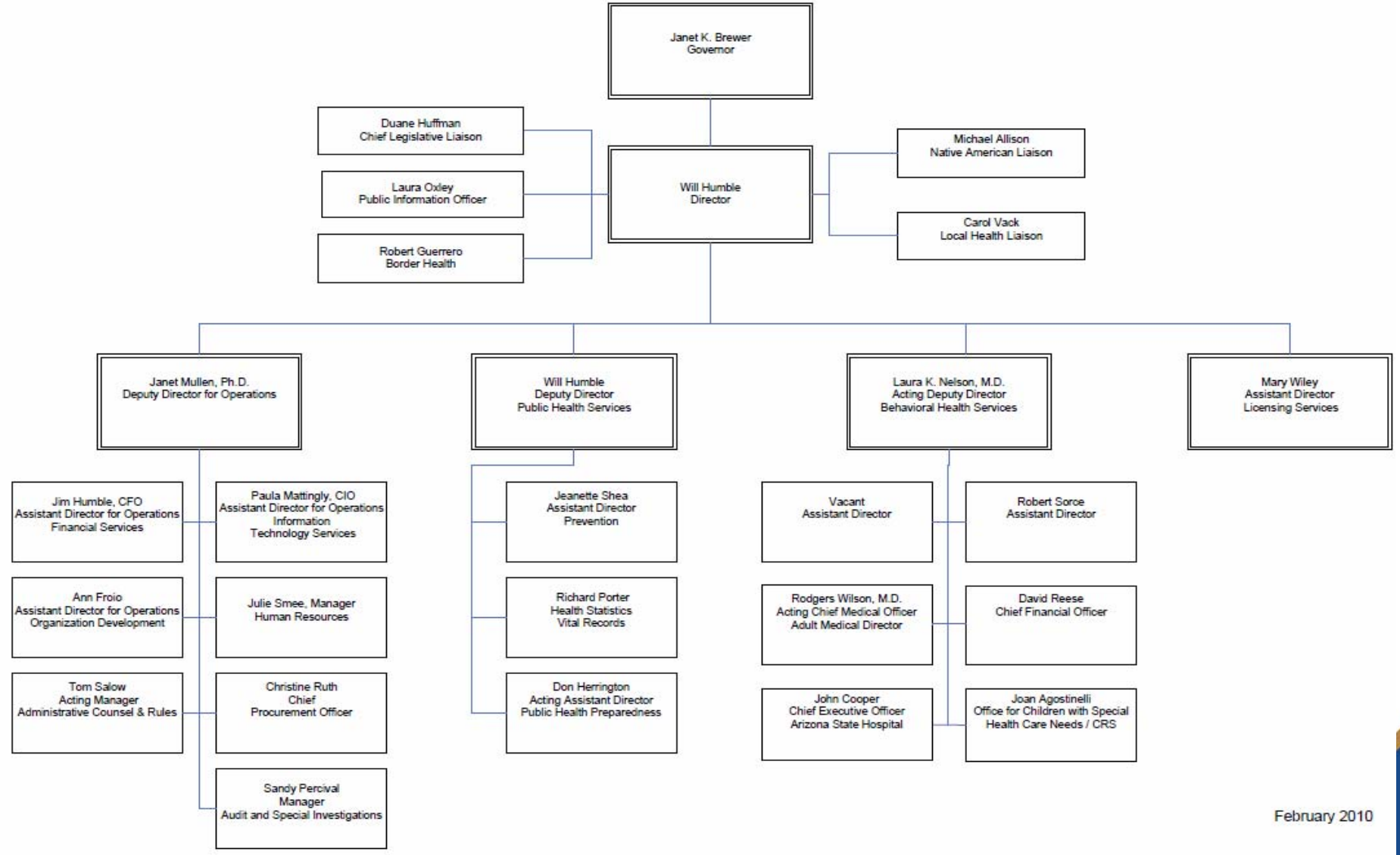
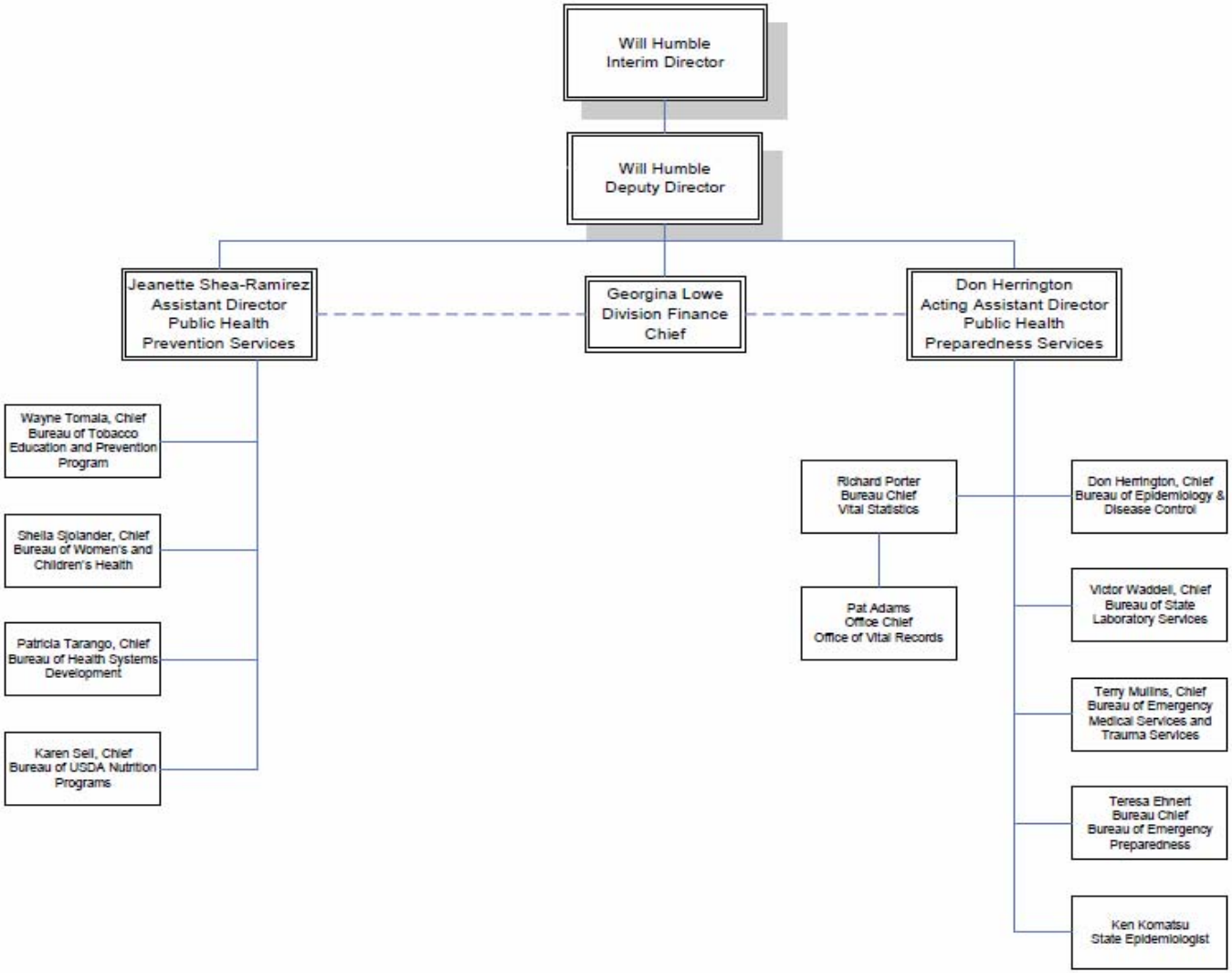
AGENCY



February 2010

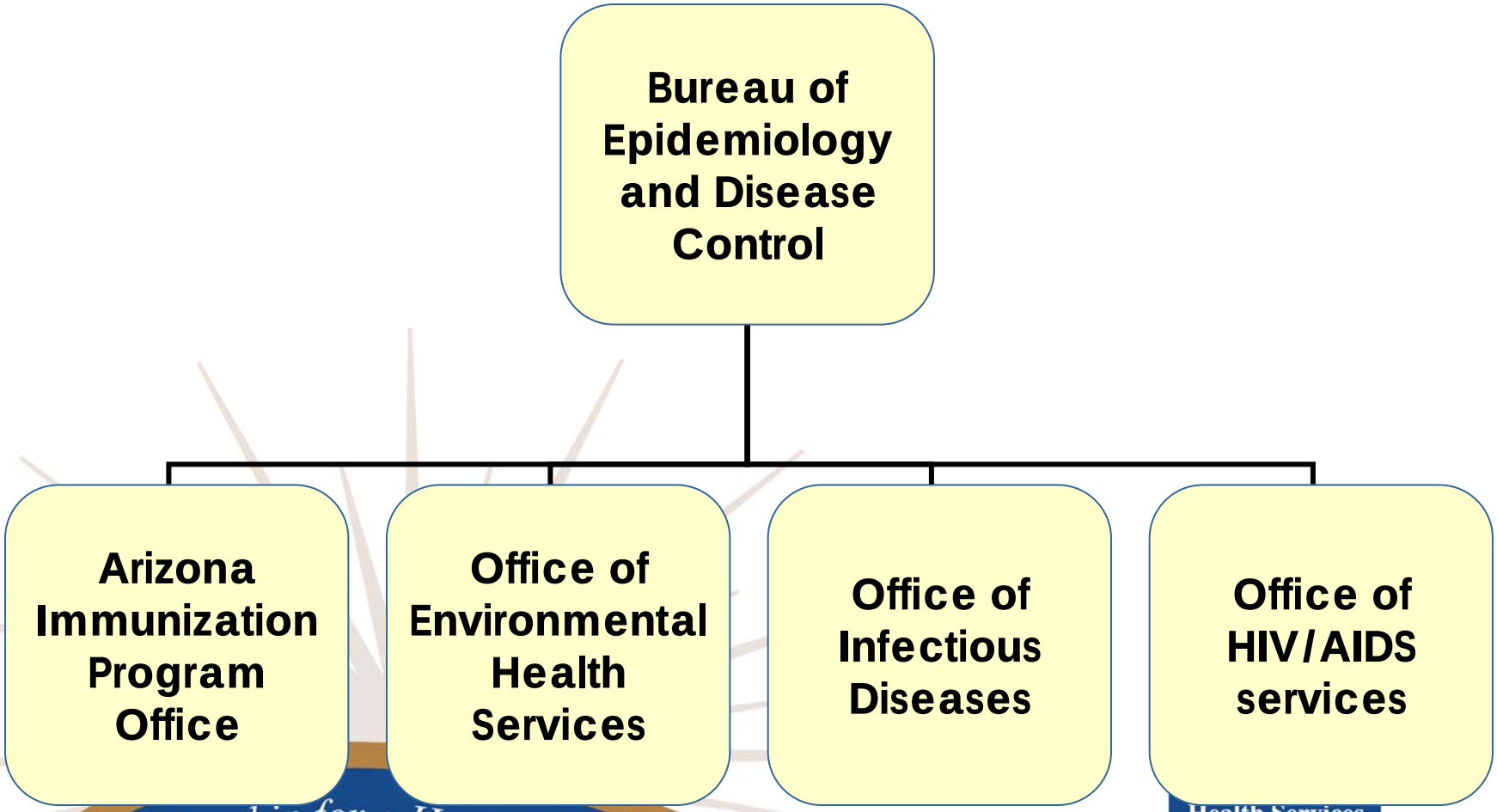
ARIZONA DEPARTMENT of HEALTH SERVICES

Division of Public Health Services

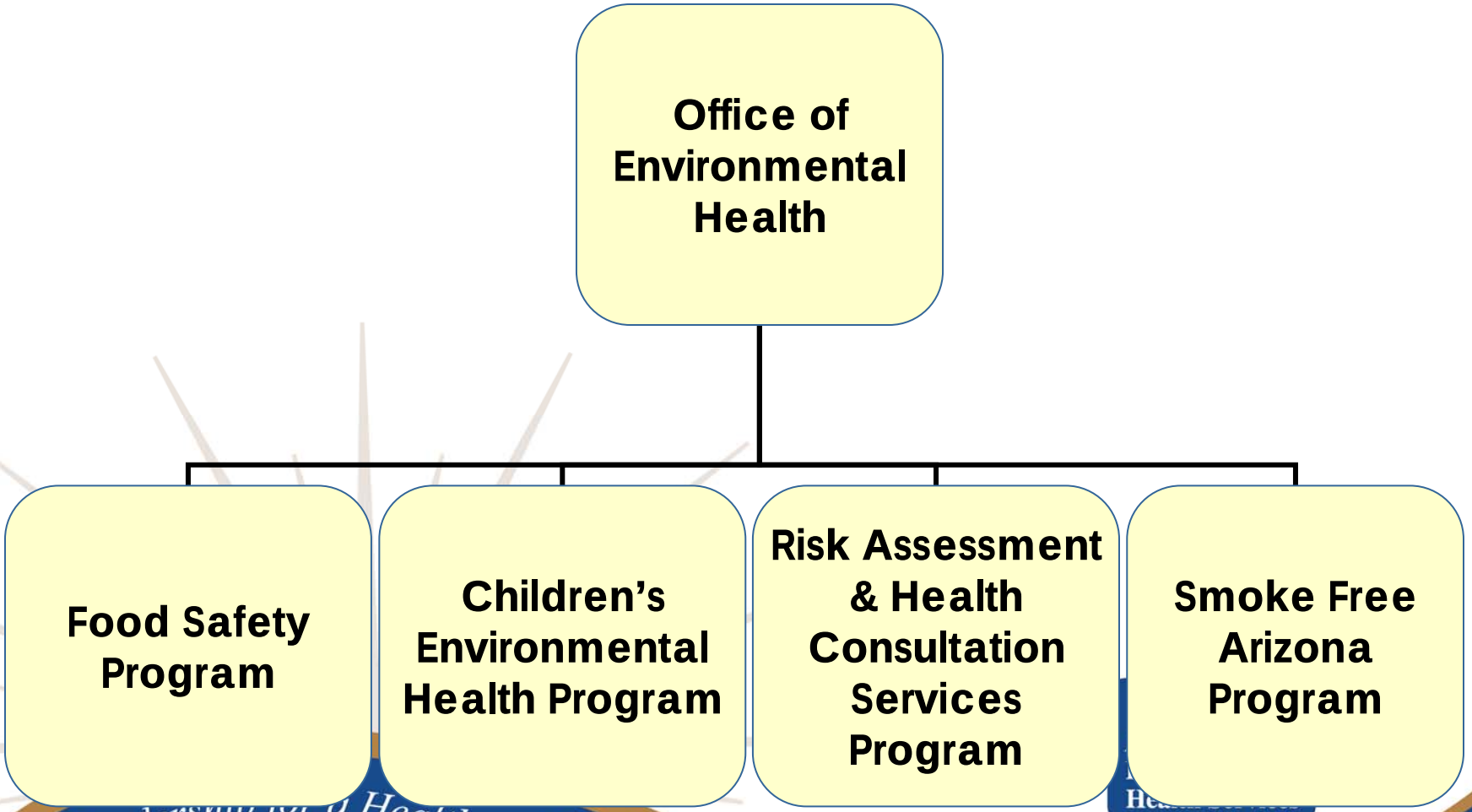


Updated August 17, 2009
Kallee Hart

ADHS – Bureau Organizational Chart



ADHS – Office Organizational Chart



ADHS' Relationship with ATSDR

- **Funding:** ADHS OEH's Risk Assessment and Health Consultation Services Program is funded by a cooperative agreement with the ATSDR (The Agency for Toxic Substances and Disease Registry)
- **Purpose:** to respond to requests to evaluate potential environmental impacts on public health and provide technical guidance for site activities, while using the best available science
- **Outcome:** This partnership provided ADHS with the necessary resources to investigate environmental health concerns and report findings

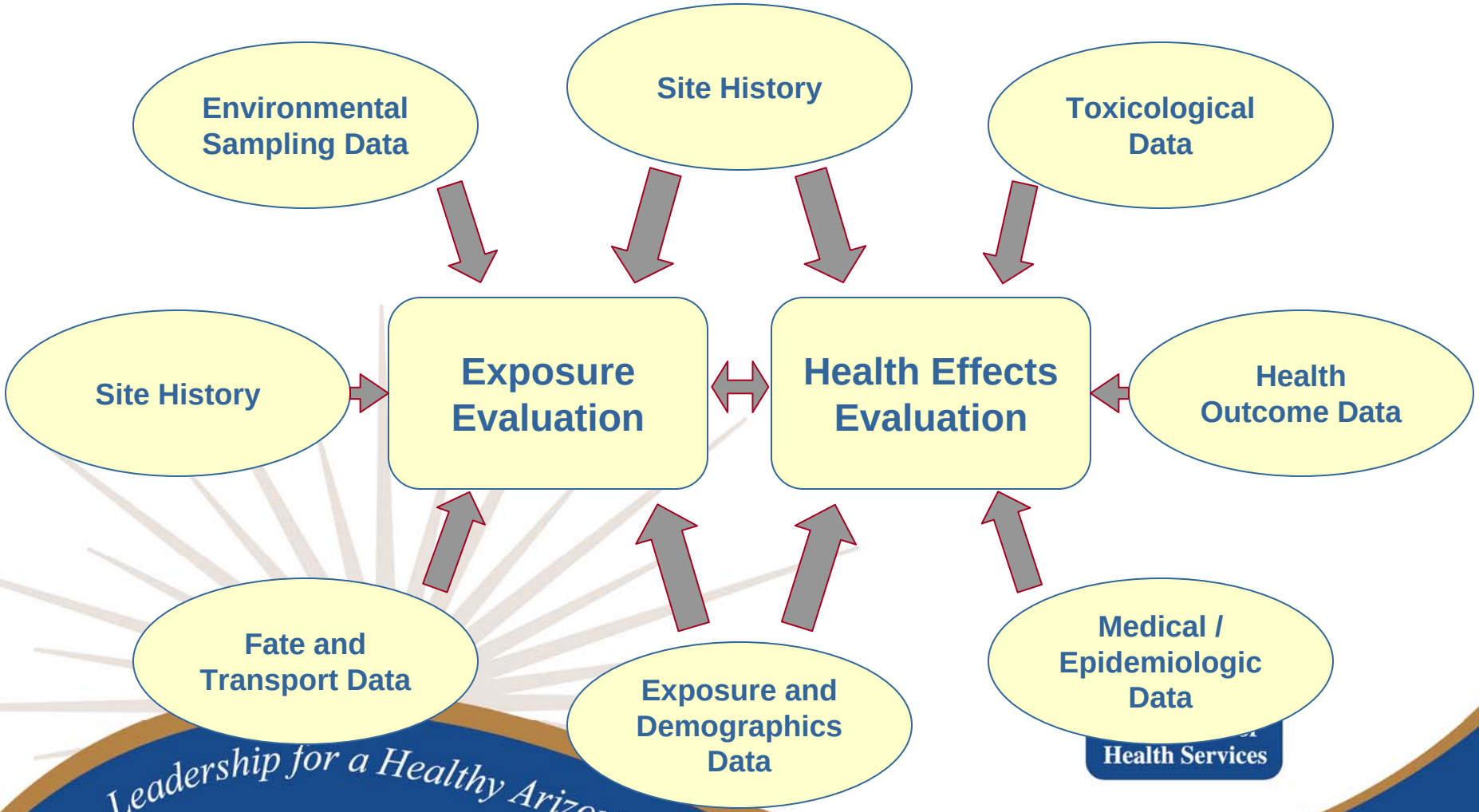
ADHS' Relationship with regulatory agencies

- ADEQ: the Arizona Department of Environmental Quality (state agency)
- EPA: the Environmental Protection Agency (federal agency)
- ADEQ and ADHS
  - Directors both report to the governor of Arizona
  - ADEQ is primarily regulatory, ADHS is primarily advisory

Health Consultation Process

- Gather available data
- Identify chemicals of concern
- Evaluate exposure pathways and duration
- Calculate dose
- Make a health conclusion
- Finalize and distribute report

Information Needed to Evaluate Exposures and Health Effects



Exposure Pathways

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Exposure Pathways

4. Exposure Route (ingestion)

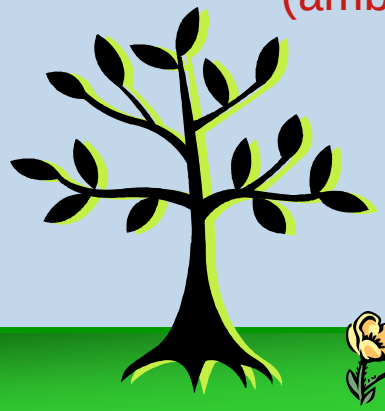
2b. Environmental Media (air)

2a. Release & Migration (volatilization)

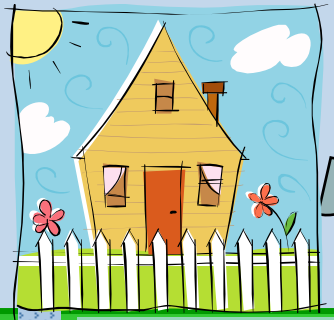
5. Potentially Exposed Population (residents)

3. Exposure Point (ambient air)

1. Source (drums)



4. Exposure Route (inhalation)



3. Exposure Point (Private wells)

2a. Release Mechanism (leaching)

2b. Environmental Media (groundwater)

Exposure Assessment

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Comparison Values

- Environmental Guidelines:
  - Concentrations (mg of substance / kg soil)
  - derived from health guidelines and represent concentrations of a substance (e.g. in water, soil, air) to which humans may be exposed via a particular exposure route during a specified period of time without experiencing adverse health effects.
  - Examples:
    - EMEG: Environmental Media Evaluation Guides
    - CREG: Cancer Risk Evaluation Guide
    - SRL: Soil Remediation Levels

Comparison Values

- Health Guidelines:
  - Doses (mg of substance/kg of body weight /day)
  - derived based on data drawn from the epidemiologic and toxicological literature with many uncertainty or safety factors applied to ensure that they are amply protective of human health.
  - Examples:
    - MRL: Minimal Risk Level
    - RfD: Reference Dose
    - RfC: Reference Concentration
    - Cancer Slope

Exposure Equation Example
(drinking water pathway)

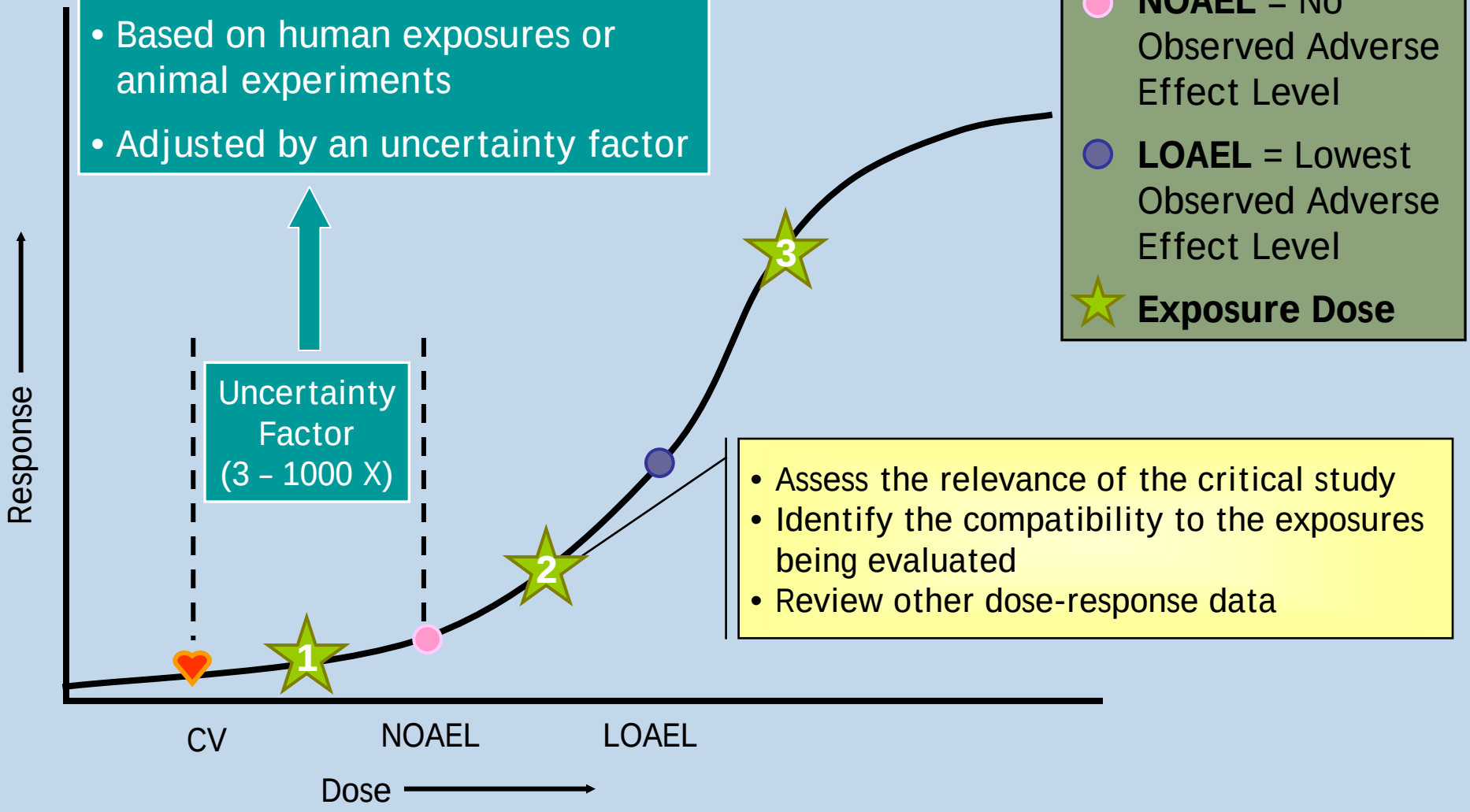
$$\text{Daily Dose (mg contaminant/kg body weight-day)} = \frac{\text{Conc}_{(\text{water})} \times \text{Inges Rate}_{(\text{liters/day})} \times \text{Exp Freq}_{(\text{days/yr})} \times \text{Exp Dur}_{(\text{years})}}{\text{Body Weight}_{(\text{kg})} \times \text{Averaging Time}}$$

Comparison Values

- Agency for Toxic Substances and Disease Registry (ATSDR)
  - **MRL** = Minimal Risk Level
- Environmental Protection Agency (EPA)
  - **RfD** = Reference Dose
  - **RfC** = Reference Concentration

Health Based Comparison Values vs. Exposure Dose

- Amount of chemical/unit of body weight where non-cancer health effects are not likely to occur
- Based on human exposures or animal experiments
- Adjusted by an uncertainty factor



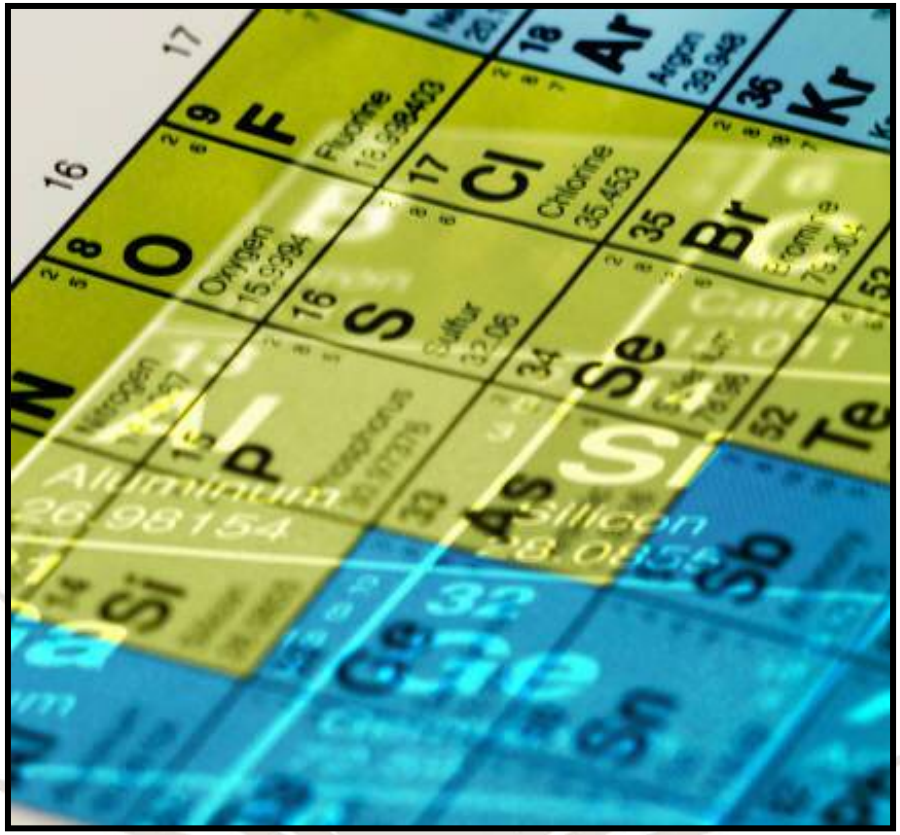
CV = Comparison Value

NOAEL = No Observed Adverse Effect Level

LOAEL = Lowest Observed Adverse Effect Level

Exposure Dose

- Assess the relevance of the critical study
- Identify the compatibility to the exposures being evaluated
- Review other dose-response data



Toxicity:

"The dose makes the poison"

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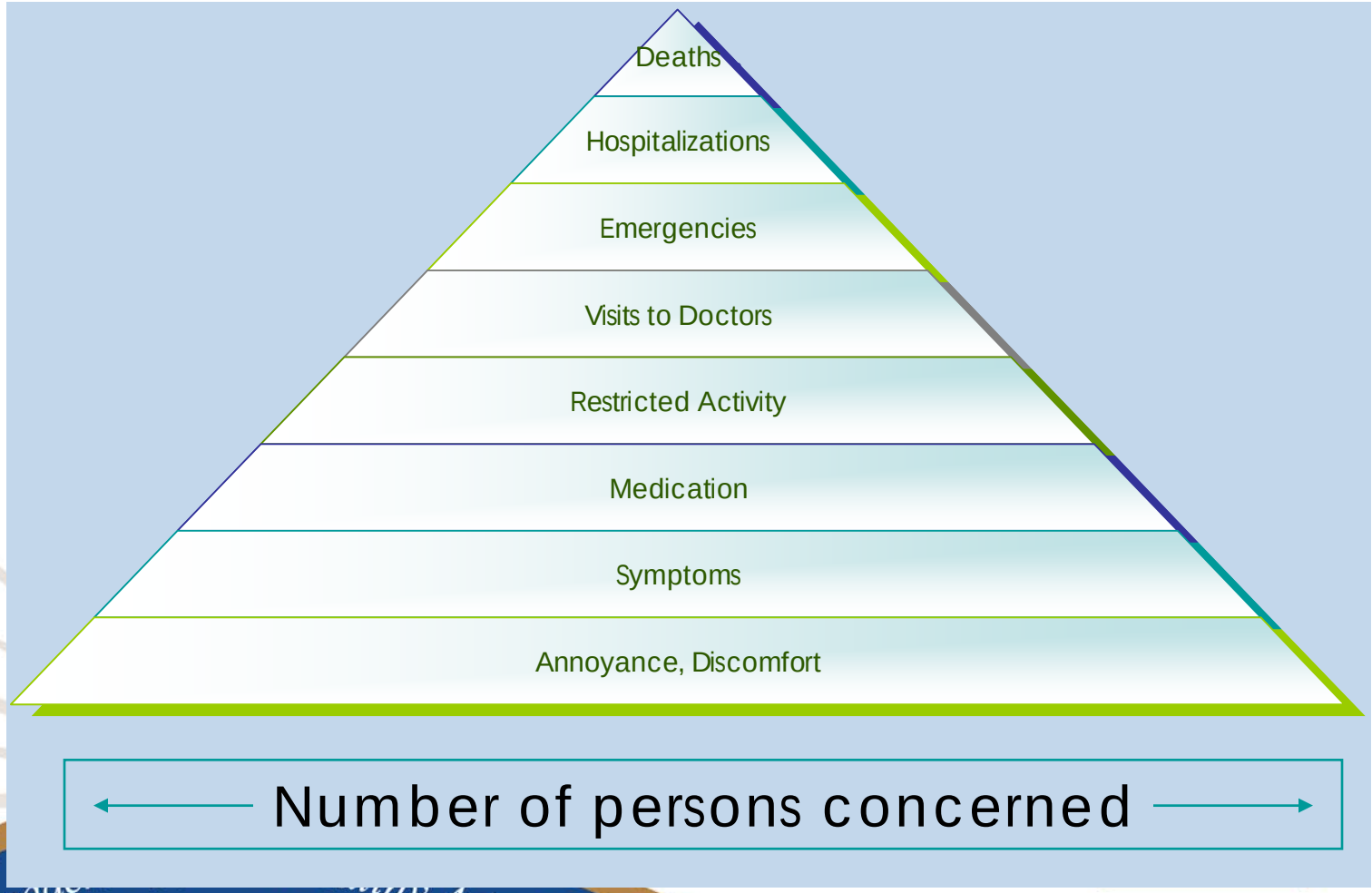
Response

- Chemicals cause their effects (either harmful or beneficial) by changing the way cells function

Toxicant	Acute Toxicity	Chronic Toxicity
Ethanol	CNS depression	Liver cirrhosis
Arsenic	gastrointestinal damage	Skin/liver cancer

If members of a group are exposed identically, a range of health effect responses can result



Health Consultation Conclusions

Hazard

1: Urgent Public Health Hazard
2: Public Health Hazard

- Health advisory
- Measures to stop or reduce exposures
- health education
- Health studies / surveillance

No Hazard

4: No Apparent Public Health Hazard
5: No Public Health Hazard

- Health education
- Possible health surveillance
- Measures to prevent future exposures

Unknown

3: Indeterminate Public Health Hazard

- Further characterization of site-related exposures, where possible
- Health education
- Health studies / surveillance

Health Effects of TCE

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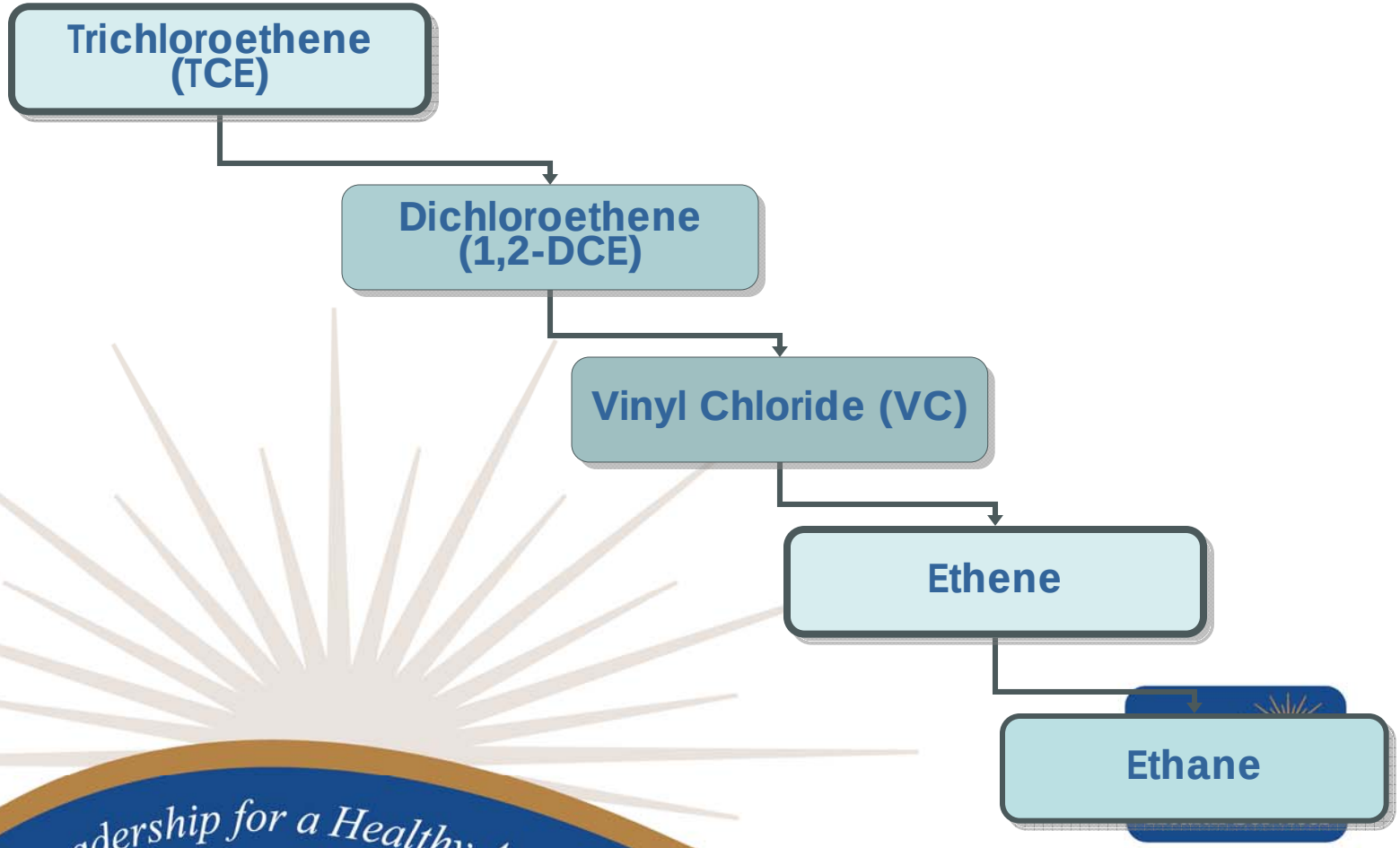
TCE in the Environment

- Trichloryethene a.k.a trichloroethylene
- TCE can remain in ground water for a long time
- TCE quickly evaporates from surface water
- TCE evaporates less easily from the soil than from surface water
- TCE may stick to particles in water, which will cause it to eventually settle to the bottom sediment
- TCE does not build up significantly in plants and animals

TCE's Breakdown products in the environment



Non Cancer Health Effects of TCE

- Acute (short exposures)
  - Inhalation
    - Headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating
    - Impaired heart function, unconsciousness, and death
  - Ingestion
    - nausea, liver damage, unconsciousness, impaired heart function, or death
  - Dermal contact
    - Skin rashes
- Chronic (long exposures- more than a year)
  - Inhalation
    - nerve, kidney, and liver damage
  - Ingestion
    - liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women

Cancer & TCE

- Animal Studies
  - liver, kidney, or lung cancer
- Human Studies
  - kidney, liver, cervix, and lymphatic system
- In its 9th Report on Carcinogens, the National Toxicology Program (NTP) determined that trichloroethylene is “reasonably anticipated to be a human carcinogen.”
- The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is “probably carcinogenic to humans.”

EPA Toxicological Review for TCE

- **Still in draft form – Should not be cited or quoted**
- Latest (November 2009) draft available online http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=215006
- Non-cancer & cancer effects reviewed include:
  - Genetic toxicity
  - Central nervous system (CNS)
  - Kidney
  - Liver
  - Immune system
  - Respiratory tract
  - Reproduction and development
  - Esophageal cancer
  - Bladder cancer
- Suggests Cancer Slope Factors
- Also reviews effects of metabolic breakdown products

Medical Tests

- Help to determine exposure, not to good at predicting health effects
- Recent Exposure – up to a week after exposure
- Small amounts
  - breath, blood, or urine
- Larger amounts
  - Blood and urine
  - Many of its breakdown products
  - Exposure to other similar chemicals can produce the same breakdown products, so their detection is not absolute proof of exposure to trichloroethylene.

Silver Creek Subdivision, Tucson, AZ

June 3, 2005

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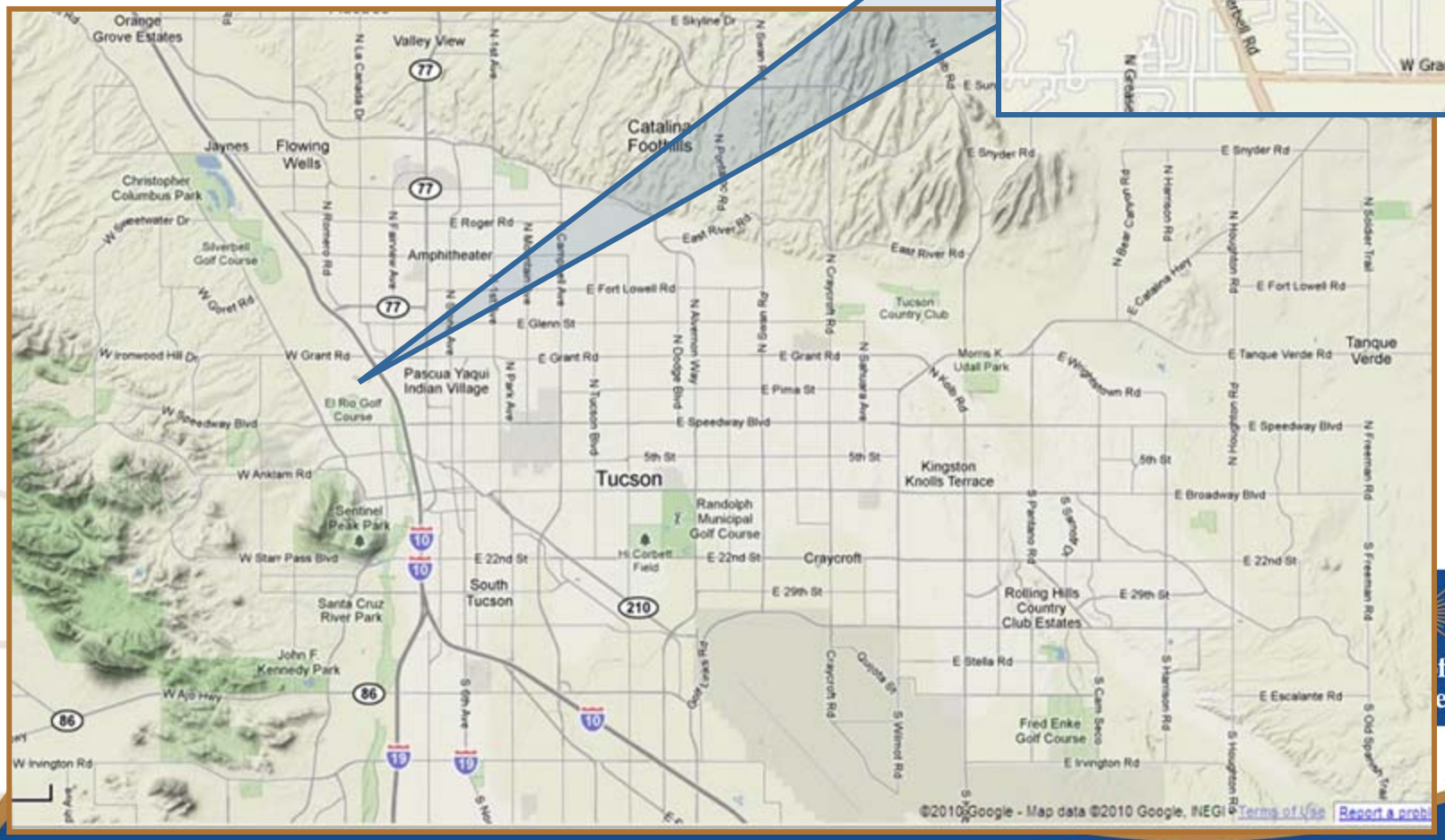
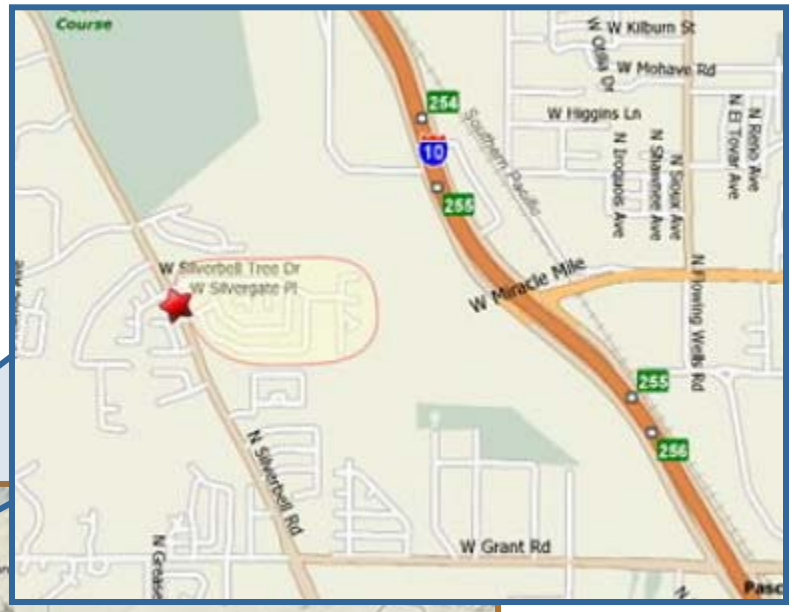
Silver Creek Subdivision, Tucson, AZ





Background

- Approximately 700 residents in 288 home subdivision
- Gasoline release from a ruptured high-pressure pipeline in Silvercroft Wash
- 50,000 gallons of gasoline had been recovered from subsurface
- Soil vapor survey
  - Sampled for Total Petroleum Hydrocarbons and related compounds (BTEX); PCE, TCE also detected
- ADEQ asked ADHS to evaluate the vapor intrusion pathway

ADHS Response

- Health Consultation
  - Examined the exposure scenario
  - Reviewed flux chamber sampling data
    - Over open soil
    - On concrete slab
  - Used data to estimate indoor air concentrations using standard box models (SECOR 2005)
  - Compared sampling data to Comparison Values
  - Compared sampling data to Cancer Screening Values
  - Calculated cancer risk
  - Made health call

Conclusions

- These calculations were based on a 30-year exposure for non cancer health effects and 70-year exposure for cancer health effects
- The predicted indoor air concentrations in Silver Creek neighborhood suggest that the subsurface contaminants pose no apparent public health hazard

Limitations

- Uncertainties exist in risk analysis, however, the report used a conservative (or upper-bound analysis)
- Indoor air concentrations were estimated using flux chamber air sample data collected at the site
- The air concentrations used represent environmental conditions at one point in time

Health Consultation

STATE OF ARIZONA
SILVER CREEK SUBDIVISION

TUCSON, PIMA COUNTY, ARIZONA

JUNE 3, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Final Report

Arizona Department of Health Services

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