# Using Whole Effluent Toxicity Testing to Evaluate the Environmental Performance of Onshore E&P Products

Angela Young & Dr. Amy Risen

MI SWACO
A Schlumberger Company

# Outline

- Onshore E&P product testing
- Choosing a test organism
- Method description and modifications
- Results
- Comparison with other regulatory limits
- Conclusions

MI SWACO
A Schlumberger Company

# Onshore E&P Product Environmental Safety

Clear guidelines exist for testing offshore products and fluids because there are discharges into the marine environment.

No guidelines currently exist for onshore products or fluids because there are no intentional discharges.

**New onshore test method development focused on accidental drilling fluid spills on site**

MI SWACO
A Schlumberger Company

# The Test Species:

***Pimephales promelas* – Fathead Minnow**

- Entire life in water column
- Easily cultured
- Medium sensitivity level
- Abundance of background information

MiSWACO
A Schlumberger Company

# Exploring Two Different 96-hr LC50 Test Methods

- **Modified EPA 1619**

- Used to set limitations for offshore drilling fluids

- **Modified EPA WET 2000**

- Similar method used by the U.S. Fish and Wildlife Service (FWS)

- Similar method used by the California department of Toxic Substance control

MI SWACO
A Schlumberger Company

# Methods Details

## EPA 1619

- Suspended particulate phase (SPP) from 1:9 mixture
- Concentrations: 1%, 3%,10%, 25%, 50% ppm SPP
- pH adjustment- 7.8 ± 0.1

**Modifications:**

- Dilution medium: Saltwater → Freshwater
- Test Species: Mysid → Fathead minnow
- Number of organisms per concentration: 20 → 10

## EPA WET 2000

- Direct Dosing
- Concentrations: 0.05%,0.1%, 0.5%, 1% 5% ppm
- No pH adjustment

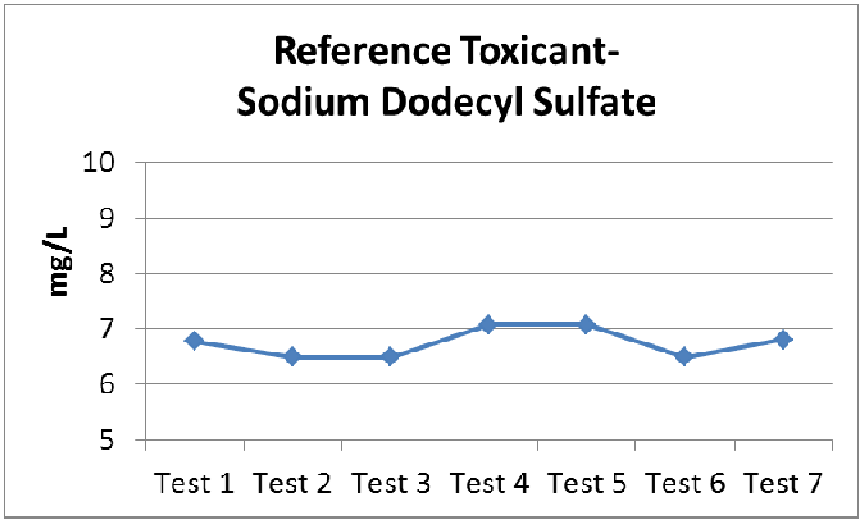
**Modifications:**

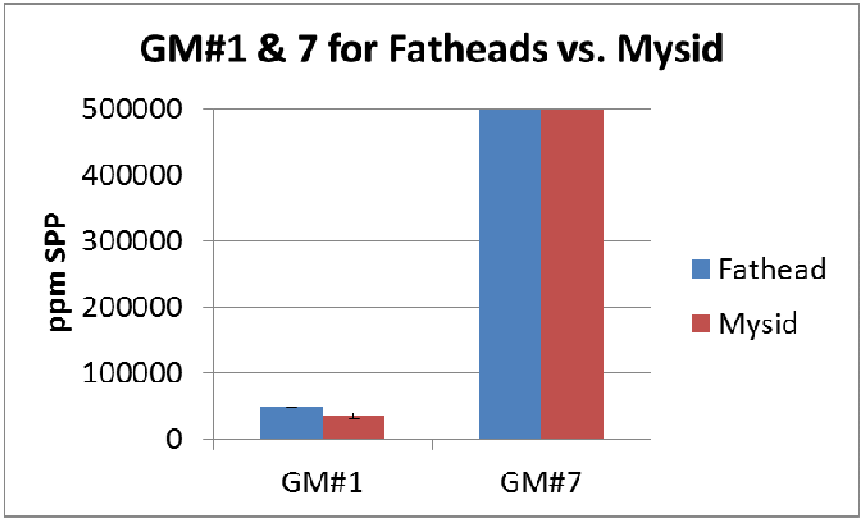
- Number of organisms per concentration: 20 → 10
- Test renewal at 48hrs → Non-renewal at 48hrs

MI SWACO
A Schlumberger Company

# Learning to Work with a New Test Species in Our Lab

- Reproducibility
- Ranks known substances correctly



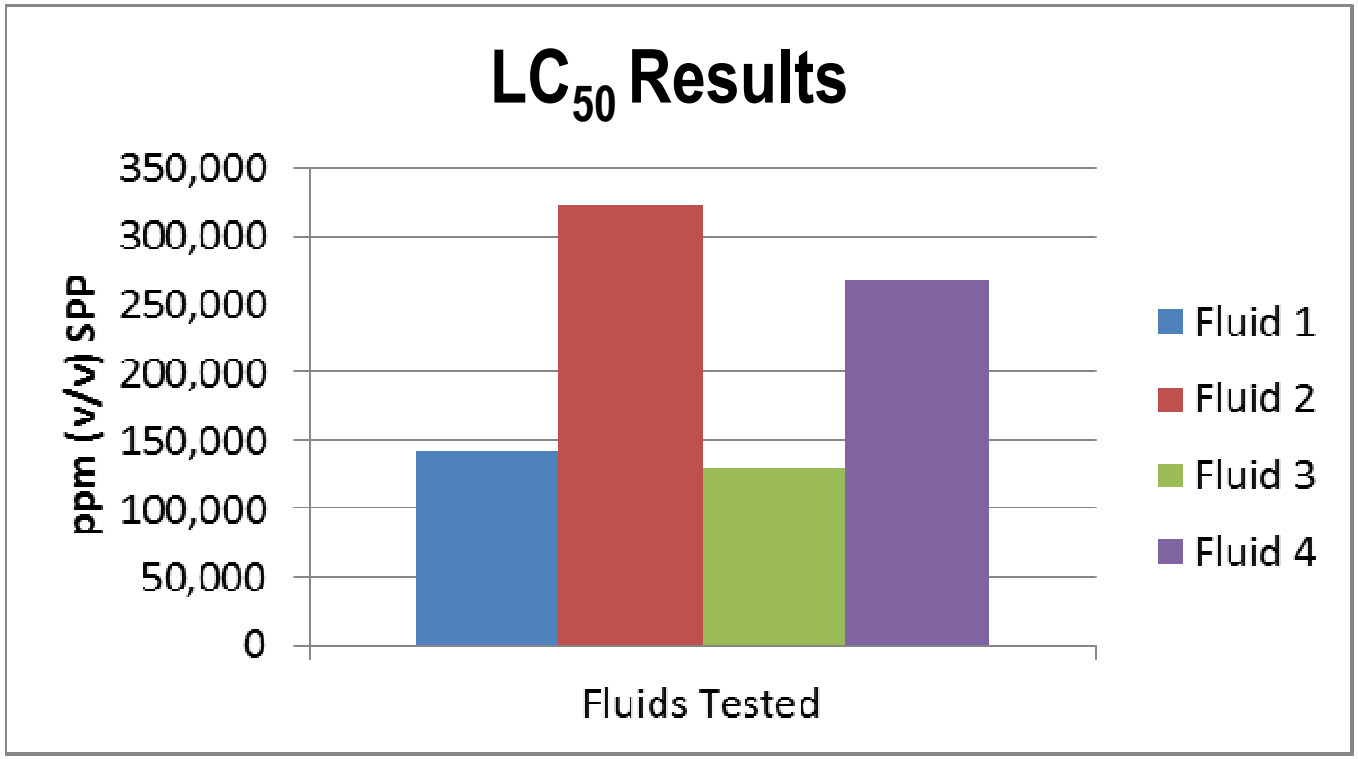

MiSWACO
A Schlumberger Company

# Test Fluids

| Sample Name | Description | Why Chosen for Testing |
|---|---|---|
| Fluid 1 | Fluid 2 w/o One Product | Currently Used |
| Fluid 2 | Common Fluid | Currently Used |
| Fluid 3 | Fluid 4 w/o One Product | Currently Used |
| Fluid 4 | Common Fluid | Currently Used |
| Fluid 5 | Old Formula | Discriminatory Power |

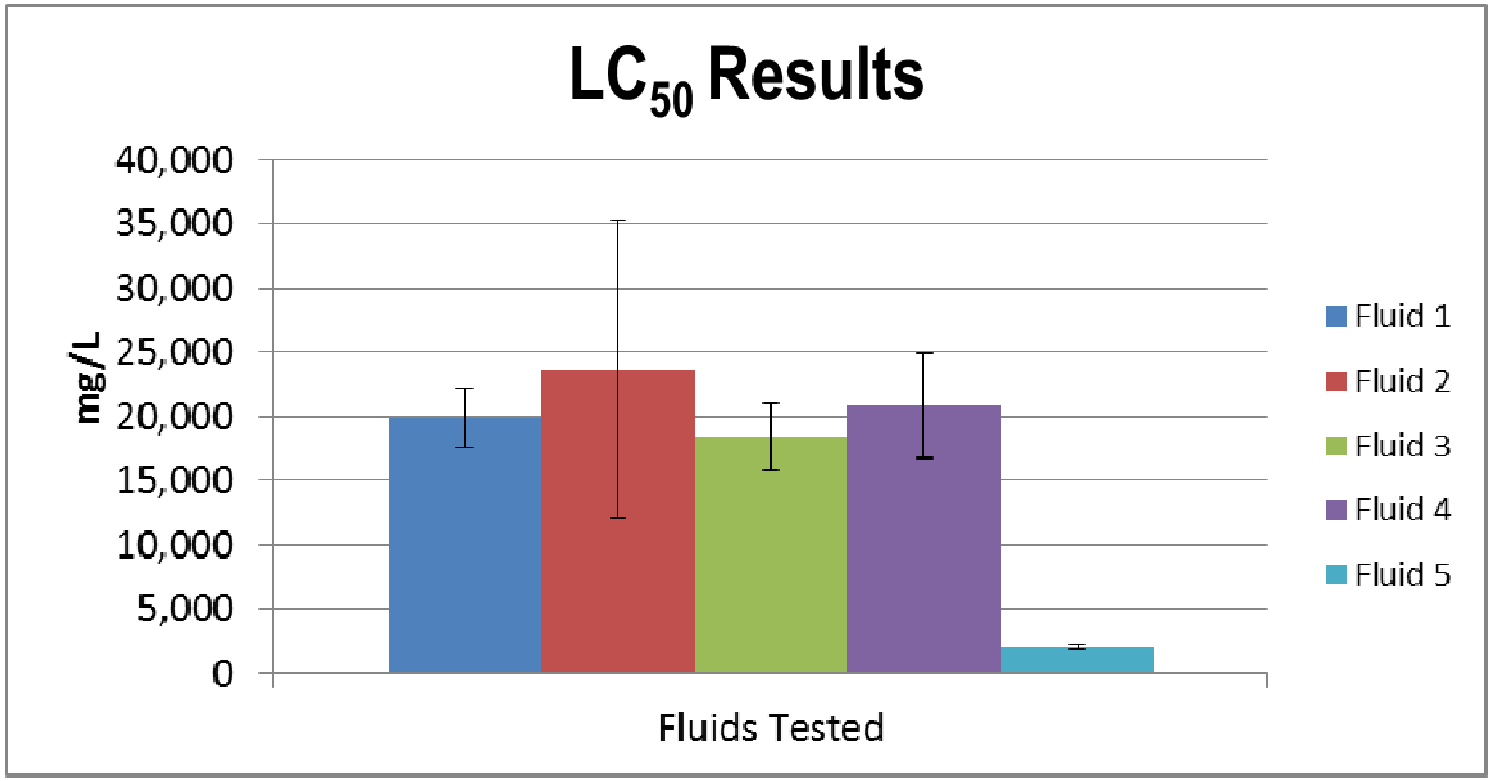
MI SWACO
A Schlumberger Company

# EPA 1619 Results




MI SWACO
A Schlumberger Company

# EPA WET 2000 Results




*EPA WET 2000 was used to test fluids 3 times. Averages and standard deviations are shown.

MI SWACO
A Schlumberger Company

# Comparing Results

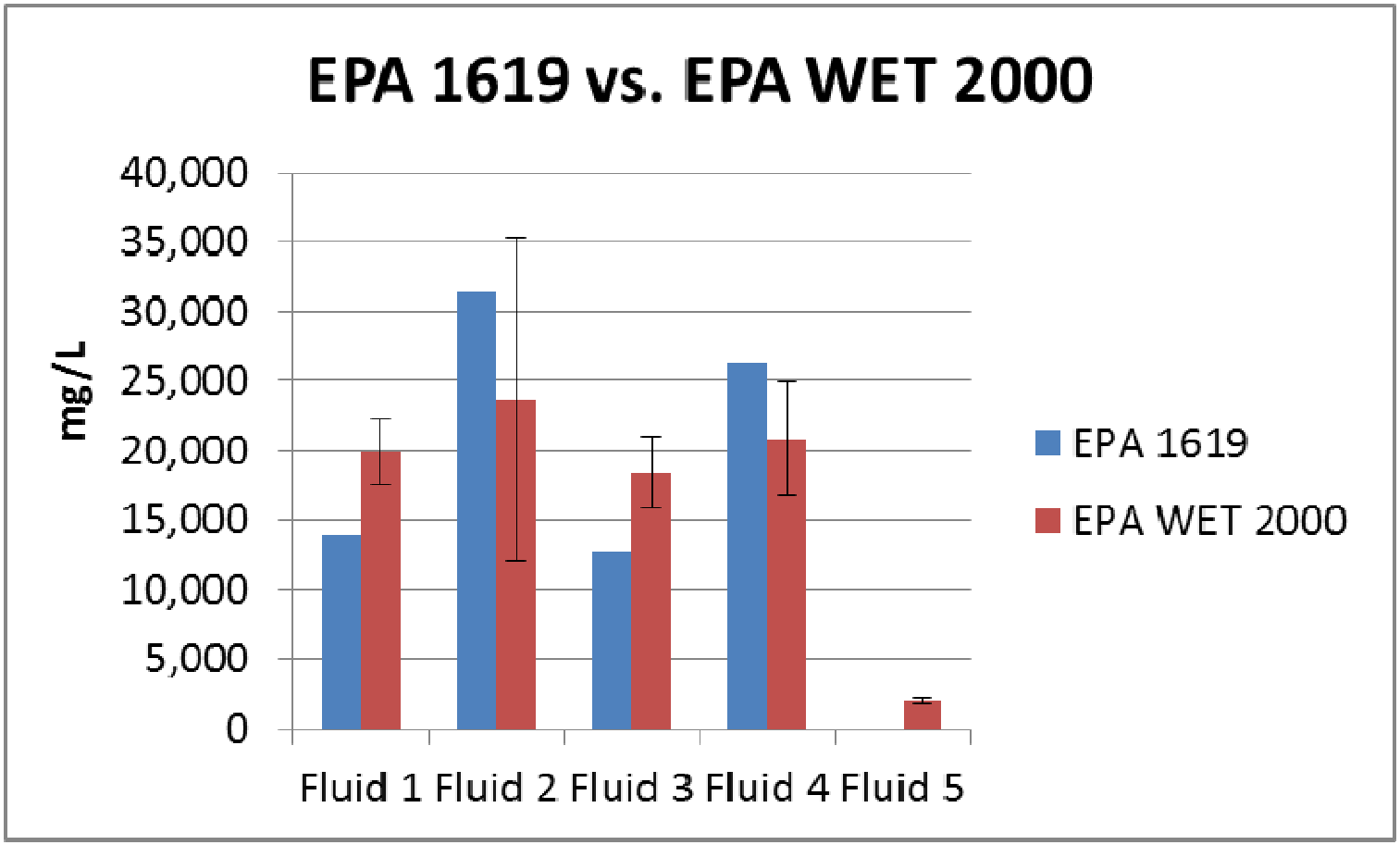
- To convert from ppm SPP to ppm (v/v) use equation:
  ppm SPP/ 10 = ppm (v/v)

- To convert from ppm (v/v) to mg/L use equation:
  ml sample /1L test volume * Density of sample (g/ml)
  = g sample/ L * 1000 = mg/L of sample.

| | Fluid 1 | Fluid 2 | Fluid 3 | Fluid 4 | Fluid 5 |
|---|---|---|---|---|---|
| EPA 1619 converted to mg/L | 13,947 | 31, 292 | 12,694 | 26,275 | N/A |
| EPA WET 2000 in mg/L | 19,887 | 23, 677 | 18,407 | 20,827 | 2,018 |

MI SWACO
A Schlumberger Company

# Comparing Results




MI SWACO
A Schlumberger Company

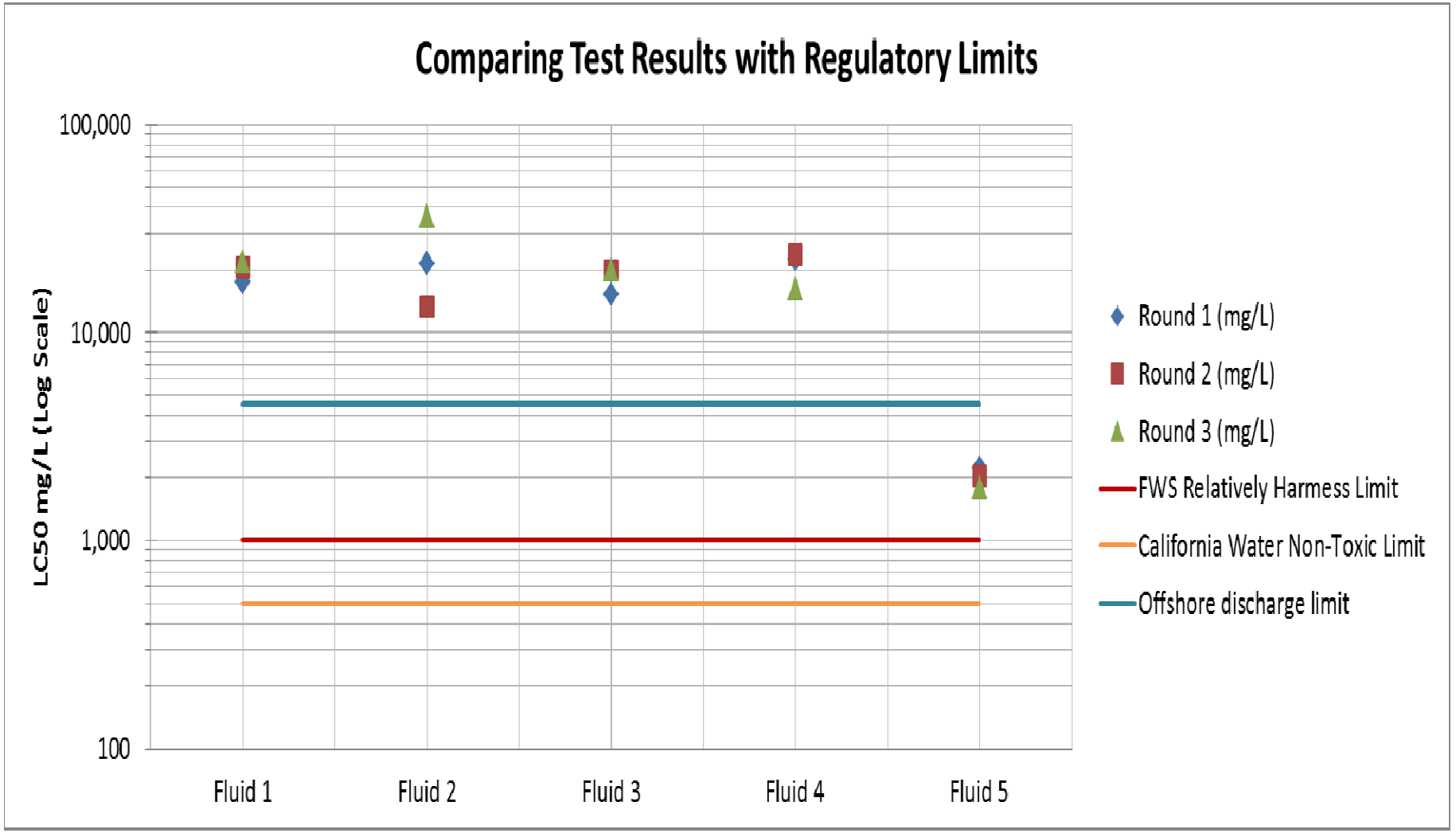
# Evaluating Results

## Regulations:

- State of California – {Title 26 sec 66261.24(6)} SMWW 18th Edition: "A waste, or material is toxic and hazardous if it has an acute aquatic 96-hour $LC_{50}$ less than 500mg/L"
- Gulf of Mexico offshore discharge permit limitation- Gulf of Mexico permit- $LC_{50}$ of ≥ 30,000 ppm SPP.

| United States Fish and Wildlife Service (FWS) | |
|---|---|
| Relative Toxicity | Aquatic $EC_{50}$ or $LC_{50}$ (mg/L) |
| Super Toxic | <0.01 |
| Extremely Toxic | 0.01-0.1 |
| Highly Toxic | 0.1-1 |
| Moderately Toxic | 1-10 |
| Slightly Toxic | 10-100 |
| Practically Nontoxic | 100-1000 |
| Relatively Harmless | >1000 |

MI SWACO
A Schlumberger Company




MI SWACO
A Schlumberger Company

# Criteria for Developing a Good Test Protocol

- Environmentally Relevant
- Repeatable
- Discriminatory Power
- Lists Commonly Known Fluids in Correct Order
- Government Acceptance

MI SWACO
A Schlumberger Company

# Conclusion

- Preliminary works shows modified EPA WET 2000 could be used to evaluate onshore E&P fluids
- Selected fluids showed low toxicity under the three reference standards used
- Additional environmental data could be explored with other test organisms or other tests (biodegradation, bioaccumulation)

MI SWACO
A Schlumberger Company

Thank you for your time!

MI SWACO
A Schlumberger Company