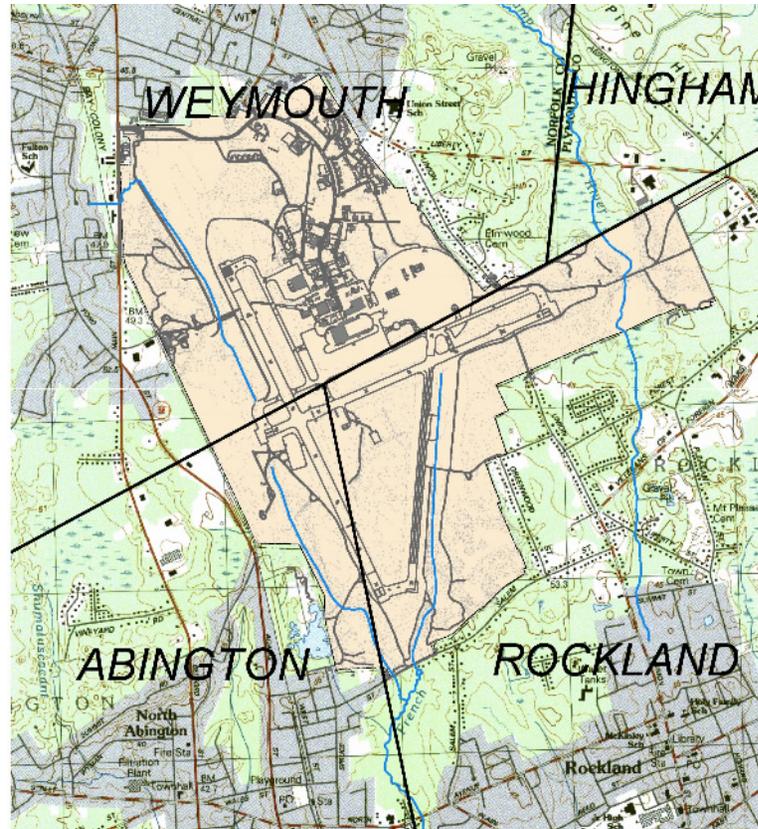


Ecological Risk Assessment Technical Memorandum Update Former NAS South Weymouth Restoration Advisory Board Meeting August 9, 2007



Objective

- Update the RAB on the Navy's progress on the Basewide Assessment
- Series of Technical Memoranda
 - ❖ Basewide Hydrogeological Evaluation
 - » December 2006 (agency comments received)
 - ❖ French Stream Geochemical Evaluation
 - » Floc Assessment (French Stream) (agency comments received)
 - » January 2007
 - ❖ Human Health Risk Assessment
 - » April 2007 (in agency review)
 - ❖ Ecological Risk Assessments
 - » French Stream
 - » Higher Trophic Level Basewide
 - » Submitted in August 2007



Tonight's Objective

- Update the RAB on the results of the Ecological Risk Assessments (ERA)
 - ❖ French Stream: Lower Trophic Level
 - » Fish and macroinvertebrates
 - ❖ Basewide: Higher Trophic Level
 - » Birds and mammals
- Tonight's presentation represents Navy perspective
 - ❖ ERAs will be submitted for agency review in August 2007

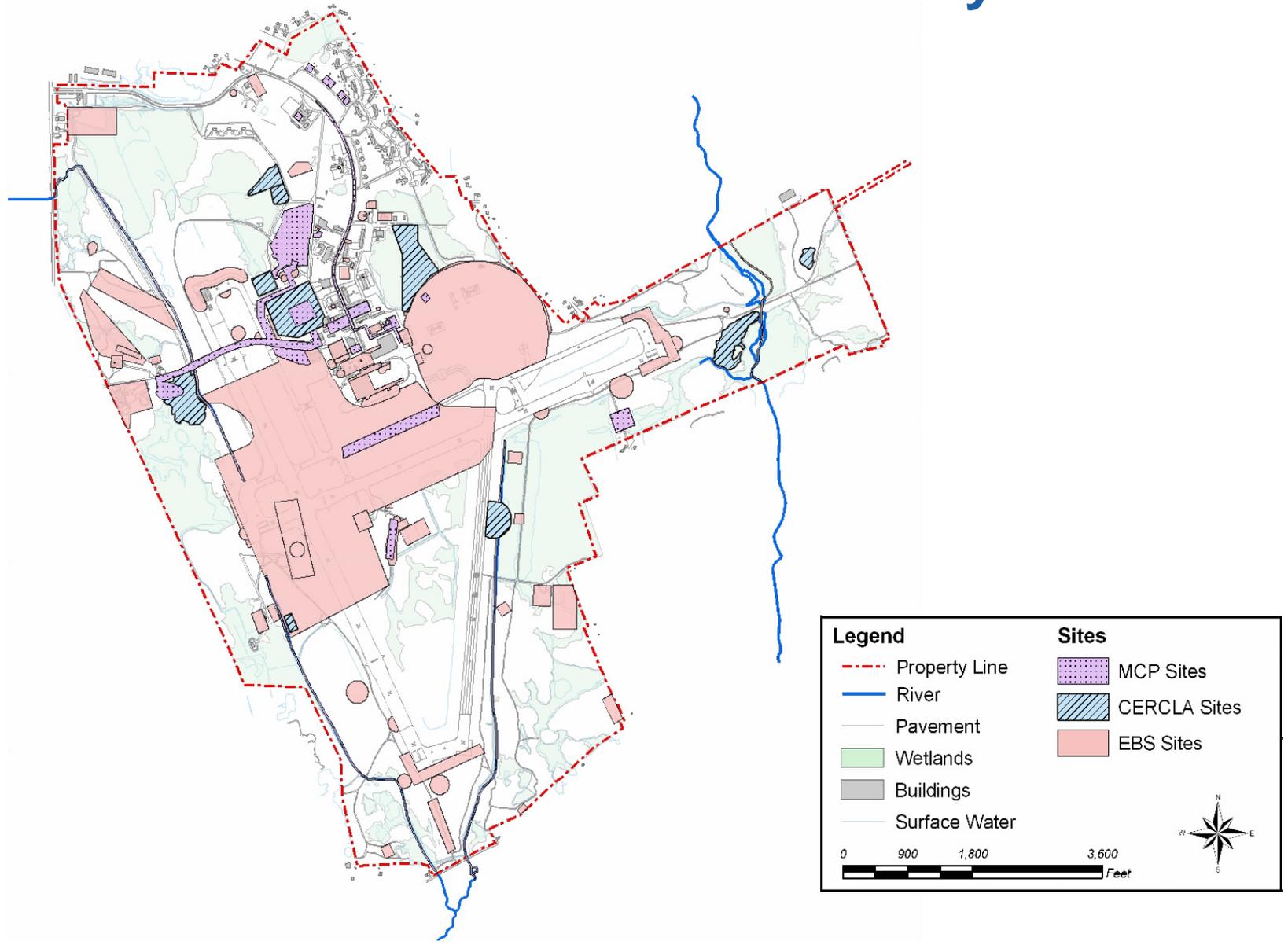


Purpose of Basewide ERA

- Evaluate potential ecological risks to:
 - ❖ Benthic and aquatic receptors from exposure to surface water, sediment, and iron flocculent material in French Stream
 - ❖ Wildlife receptors due to Basewide exposure to chemicals in surface water, sediment, surface soil, and prey items



Environmental Sites at NAS South Weymouth



French Stream ERA



- ❖ Linear feature
- ❖ Characterized by hard bottom
- ❖ Limited deposition
- ❖ Iron floc prevalent in much of stream



French Stream ERA

- Evaluated comprehensive data set collected by the Navy under EBS, MCP and CERCLA programs
 - ❖ Focused on surface water, sediment, and floc
 - ❖ Detected chemicals included a variety of semi-volatile organics, hydrocarbon compounds, PCBs, and inorganics
 - ❖ Toxicity testing, macroinvertebrate surveys, and tissue chemistry data also included
 - ❖ Much of the data was collected during the Phase II Remedial Investigation



■ Floc data collected by the Navy were evaluated

Conceptual Model of Floc Formation

*Iron- and
manganese-
rich
groundwater
discharges into
slow moving
stream*

*Groundwater
mixes with
oxygenated
stream water*

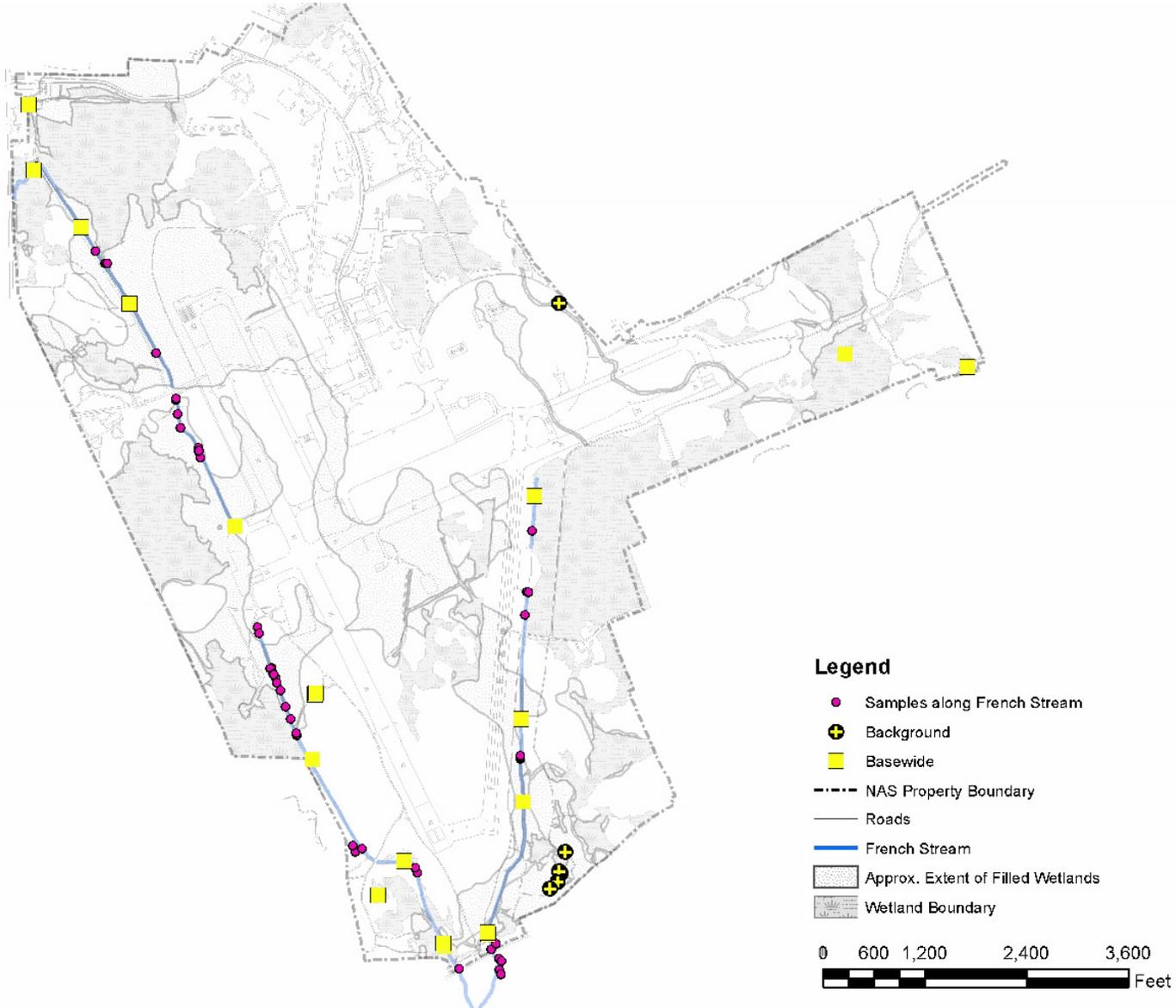
*Dissolved iron and
manganese become
oxidized and
precipitate out*

*Both an iron source and
organic matter must be
present to form floc.*

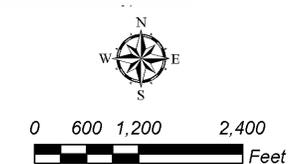
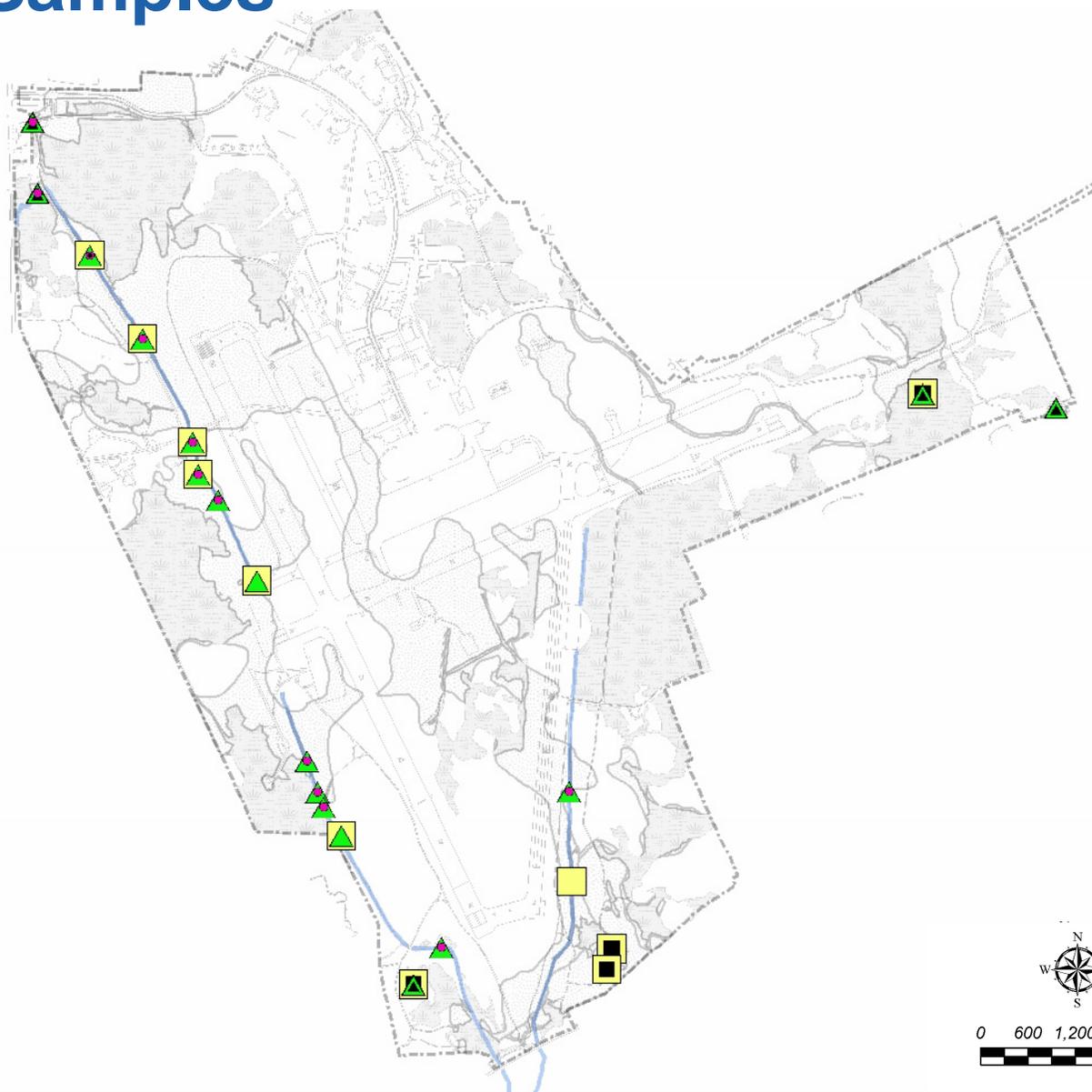
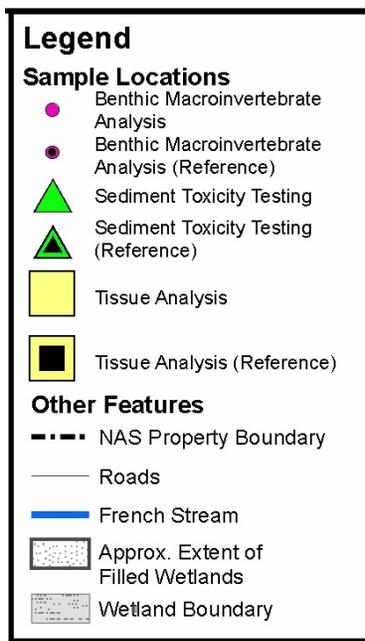
*Precipitate will settle on the
streambed or be carried
downstream, often forming
clumps of orange floc*



Surface Water and Sediment Samples



Biological Samples

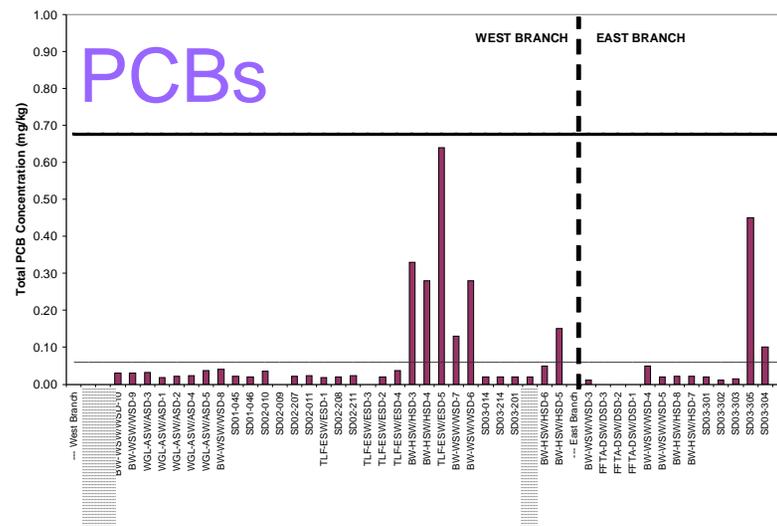
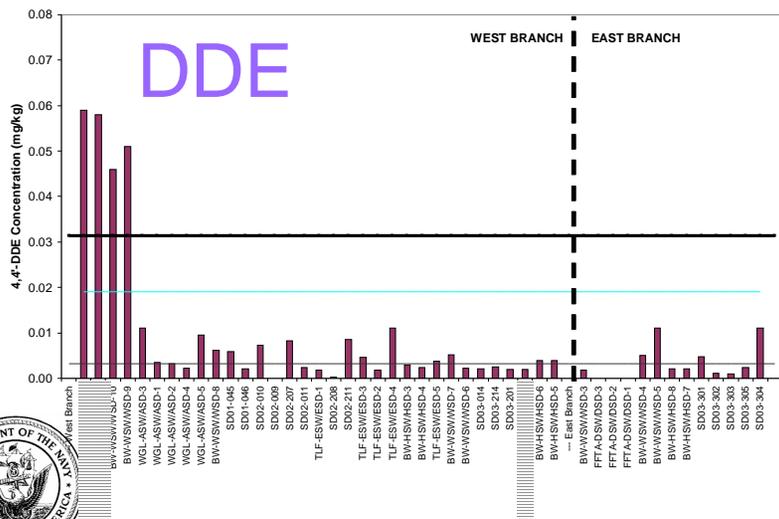
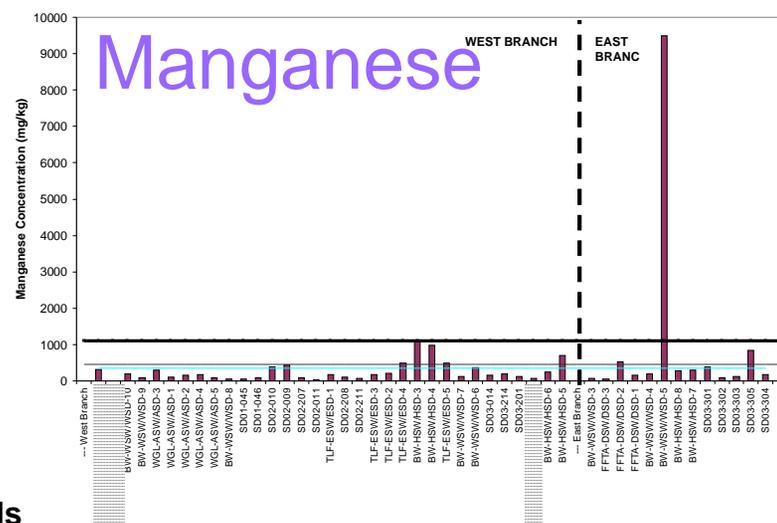
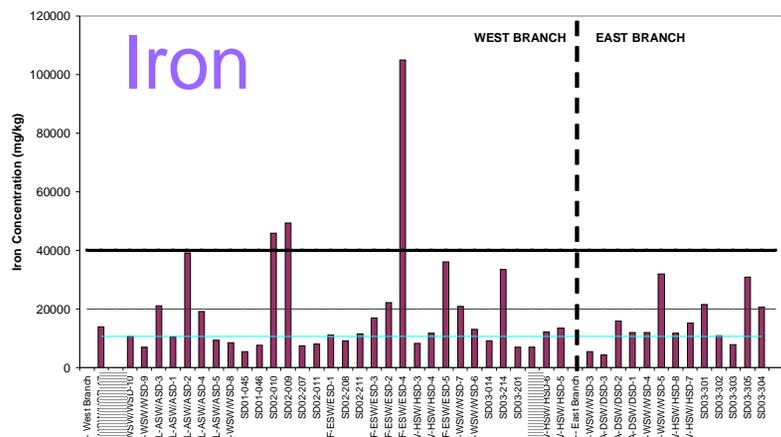


French Stream ERA Approach

- Comparison of sediment and surface water data to background samples and ecological benchmarks
- Review toxicity testing and macroinvertebrate survey results
- Evaluate concentrations of chemicals measured in tissue samples collected from French Stream
- Evaluate floc data relative to benchmarks, toxicity testing results, and macroinvertebrate survey results



Sediment Concentrations vs Ecological Benchmarks

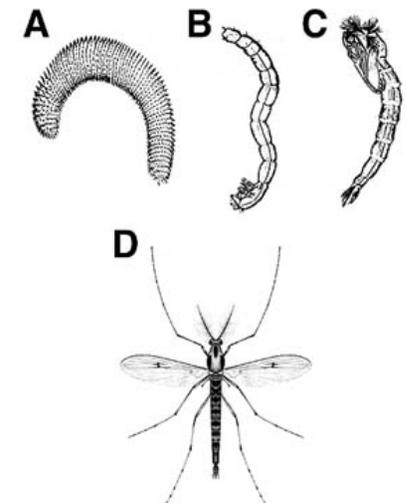


Toxicity Testing

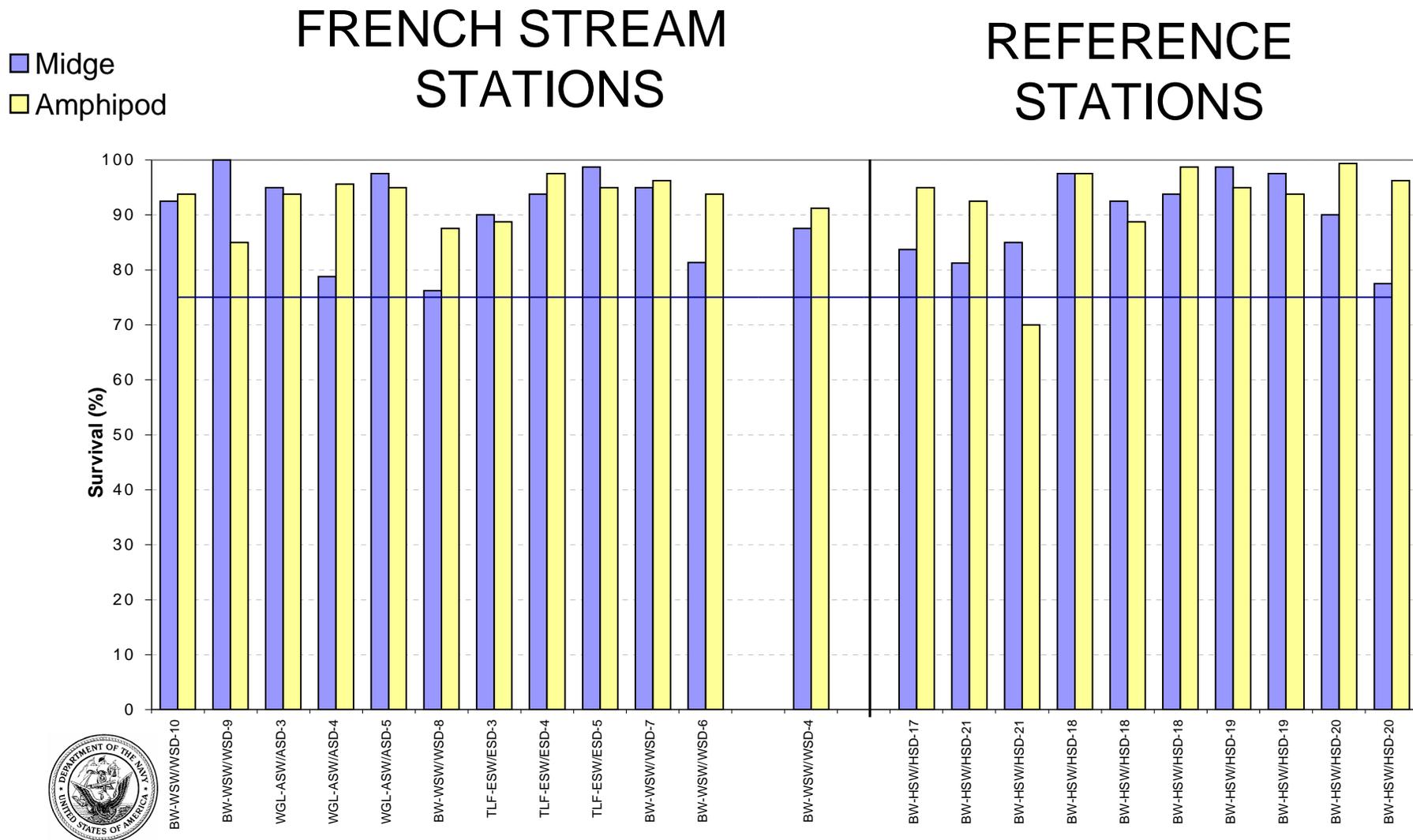
- Twelve stations within French Stream
- Five reference stations
- Two species
 - ❖ Amphipod *Hyalella azteca*
 - ❖ Midge *Chironomus tentans*
- Survival and growth measured after 10 days
- Evaluate the direct exposure of sediment-dwelling receptors to sediment in the laboratory



Photo by Scott Bauer Available at www.ars.usda.gov



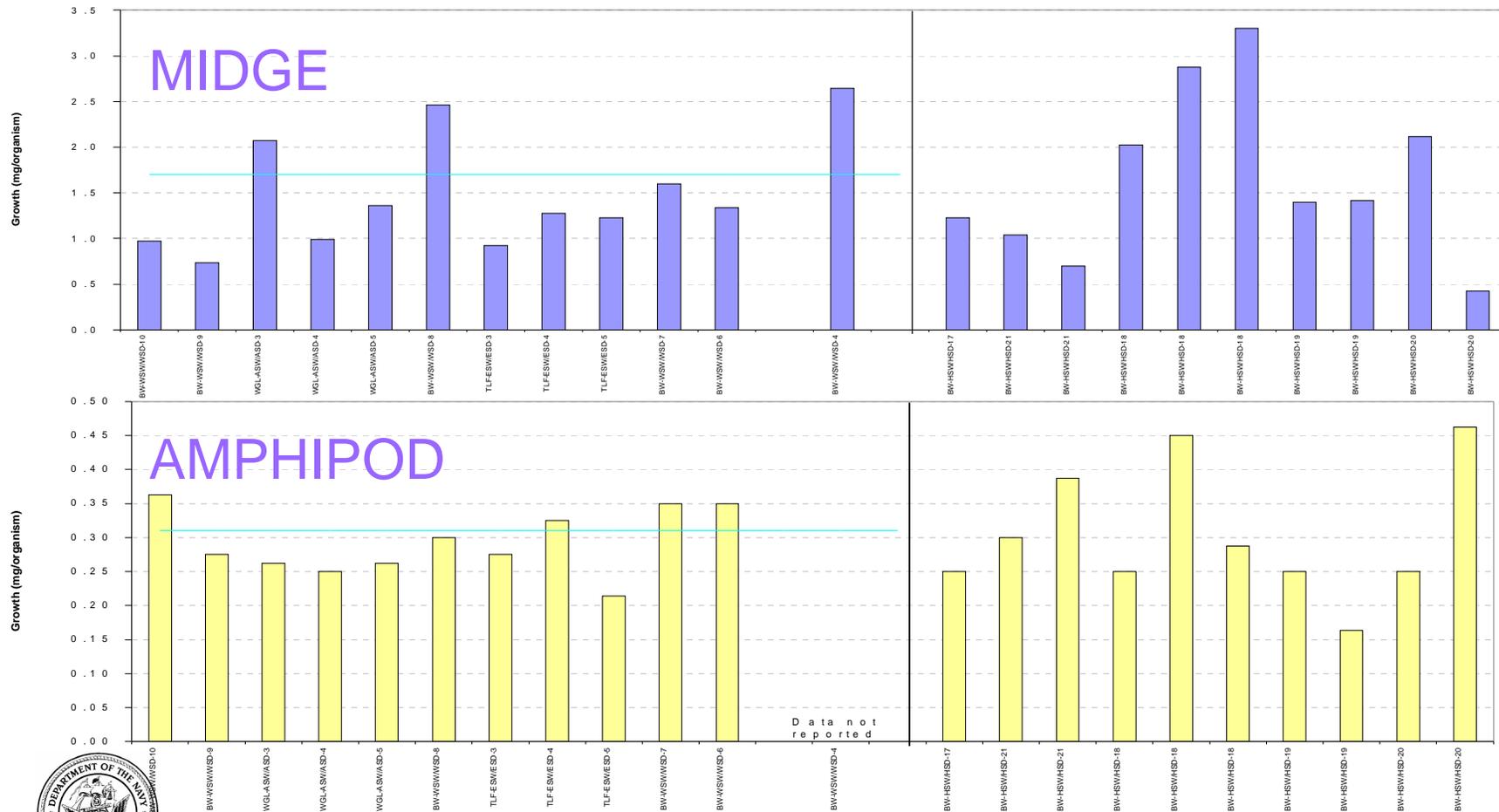
Toxicity Test Results – Survival



Toxicity Test Results – Growth

FRENCH STREAM STATIONS

REFERENCE STATIONS



Average for reference stations

Macroinvertebrate Survey Results

- Seven French Stream stations
- Provide a direct assessment of the benthic community through:
 - ❖ Abundance measures
 - ❖ Measures of taxonomic diversity and evenness
 - ❖ Investigating the association between biological, habitat condition, and chemistry
 - ❖ Statistical evaluation of sediment chemistry concentrations and macroinvertebrate metrics



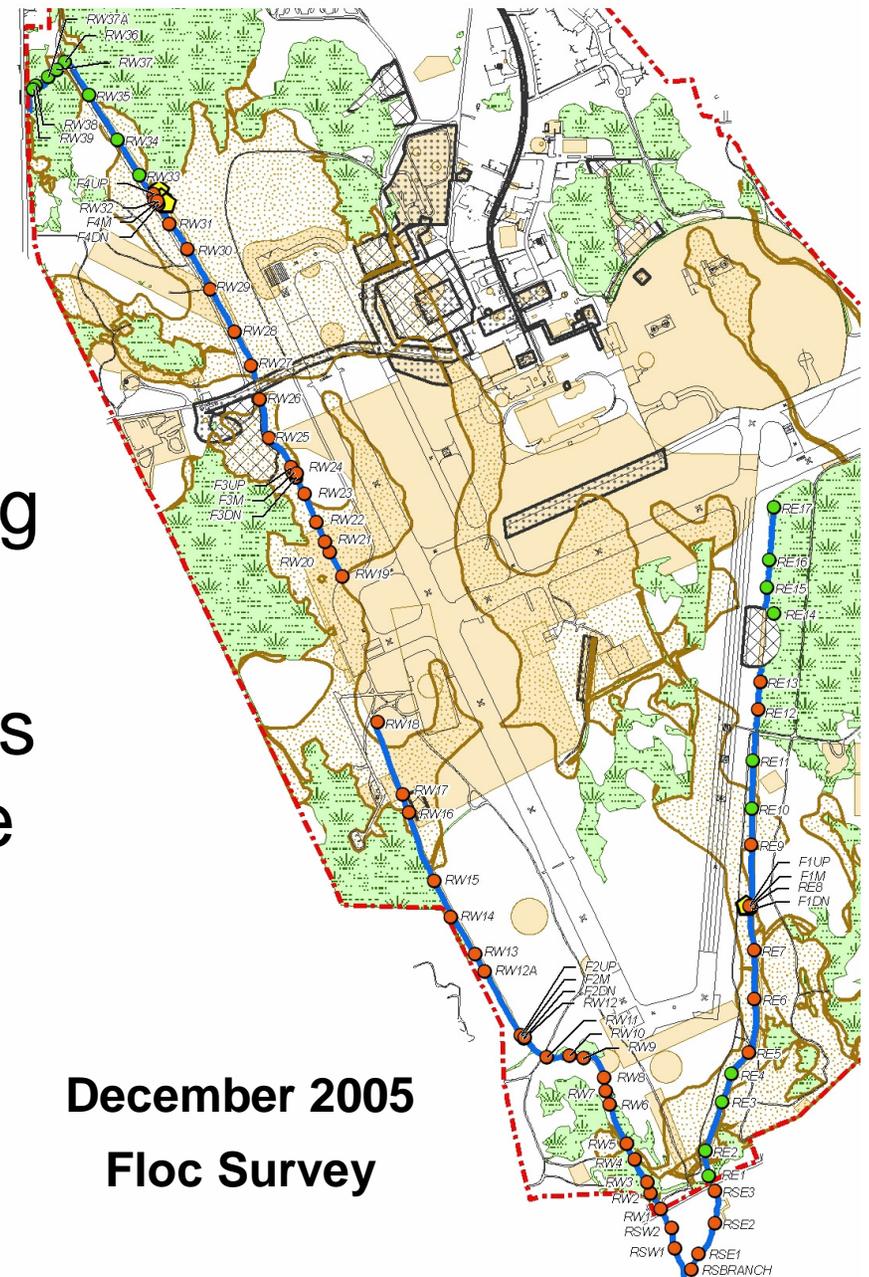
Macroinvertebrate Survey Results

- Survey indicated a moderately stress-tolerant community present throughout French Stream
 - ❖ Including at the upstream reference location
- Similar level of impairment throughout French Stream
- Not correlated with a particular chemical in sediment



Floc Survey Results

- Surveys indicated floc present throughout French Stream, including at upstream locations
- Concentrations of metals in floc exceeded surface water benchmarks



**December 2005
Floc Survey**



Other Endpoints

- Surface water concentrations exceeded benchmarks for selected metals throughout stream
 - ❖ Aluminum, barium, copper, iron, zinc
- Concentrations of chemicals measured in tissues were low
 - ❖ Similar to tissues collected from reference locations
 - ❖ Below tissue concentrations associated with adverse effects
- Statistical evaluation did not identify strong relationships between chemistry, toxicity testing, or macroinvertebrate survey results



French Stream ERA Conclusions

- Potential for adverse impacts to invertebrate, fish, and amphibian receptors in French Stream is low and limited to sub-lethal effects
- No strong relationships between chemistry and slight reductions in growth observed in the toxicity tests
 - ❖ Despite variation in sediment concentrations there was no consistent toxicological response
- Iron and manganese (major components of the floc) do not appear to be related to reductions in growth in toxicity tests
- French Stream shows some degree of impairment
 - ❖ Impairment does not appear to be related to exposure to chemicals in sediment or water and is generally similar in upstream reaches



Higher Trophic Level ERA



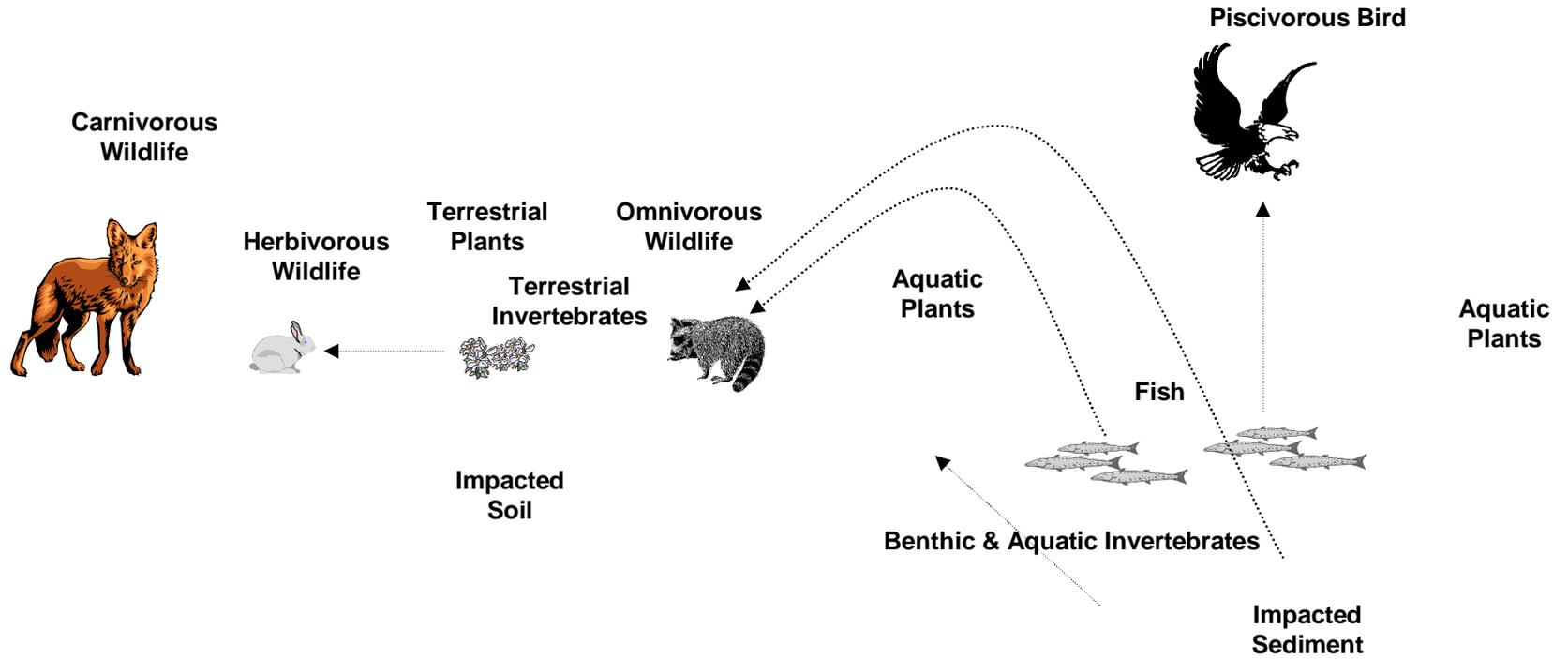
Higher Trophic Level ERA

- Designed to assess potential risks to vertebrate wildlife with large home ranges
 - ❖ Focus on carnivores and omnivores
 - ❖ Food chain uptake
 - ❖ Persistent, bioaccumulative, and toxic chemicals
- Existing chemistry data from range of Navy programs
 - ❖ Site-specific tissue residue data available
 - » Amphibian, worm, fish, mammal





Conceptual Food Web Model



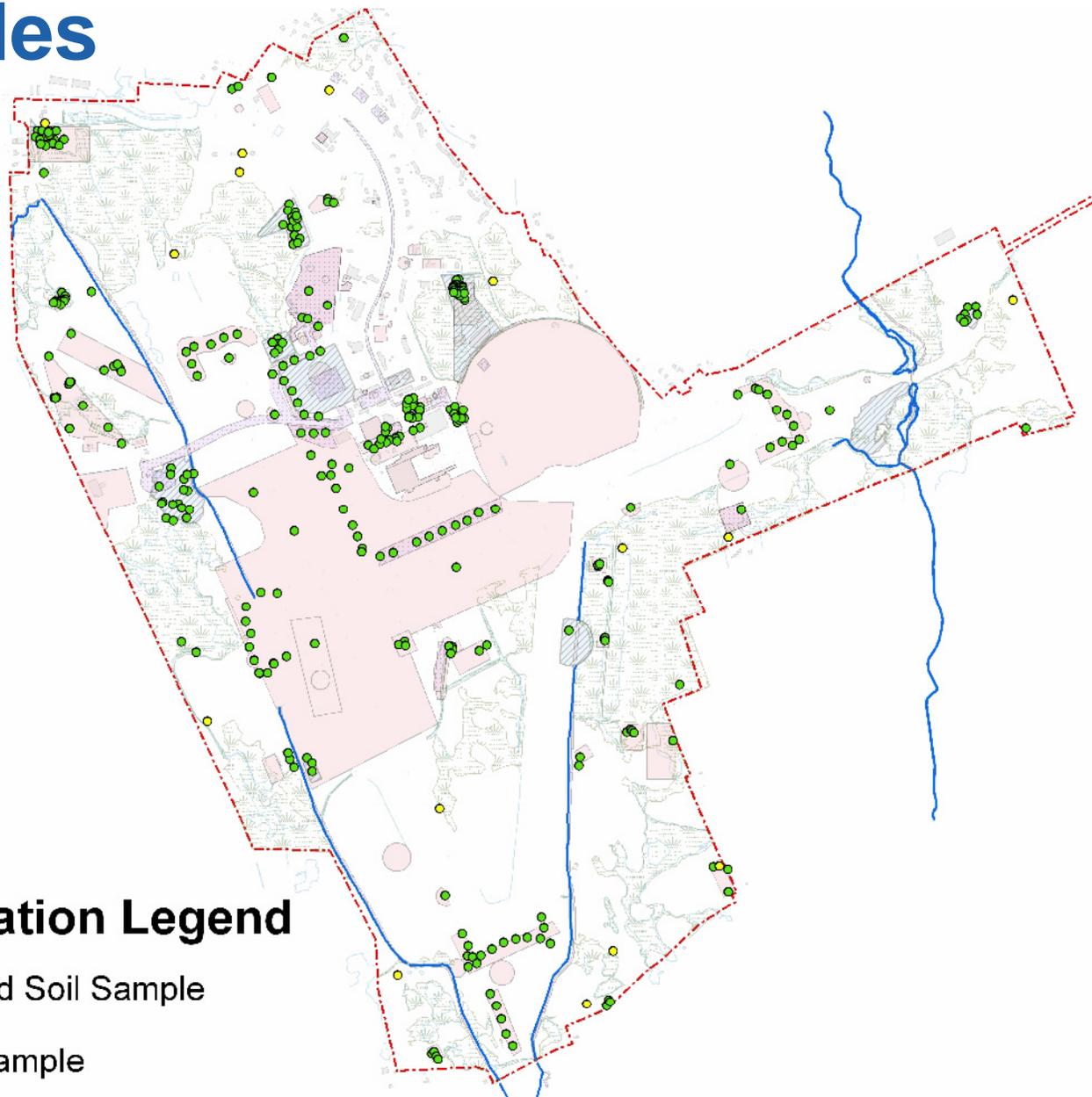
Higher Trophic Level ERA Approach

- Focus on surficial soil, surface water, sediment, and tissue data representing current conditions
- ERA recognized that some of the “hottest” data have been addressed
 - ❖ RDA, TACAN, FFTA

Medium	Number of Samples	
	Basewide	Background
Soil	382	15
Sediment	371	14
Surface Water	248	16
Tissue - amphibian	10	4
Tissue - fish	14	5
Tissue - worm	5	2
Tissue - mammal	7	2



Soil Samples

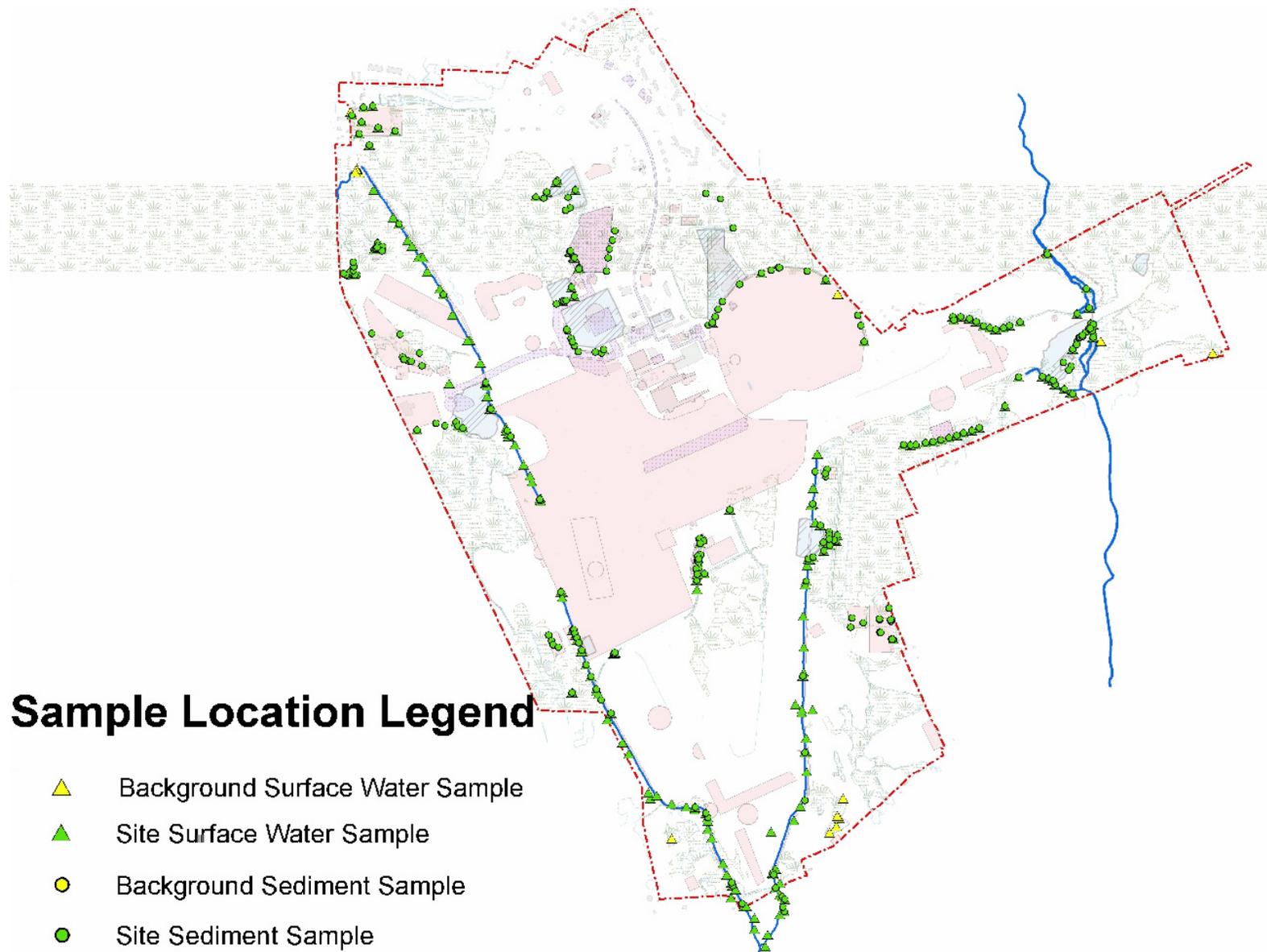


Sample Location Legend

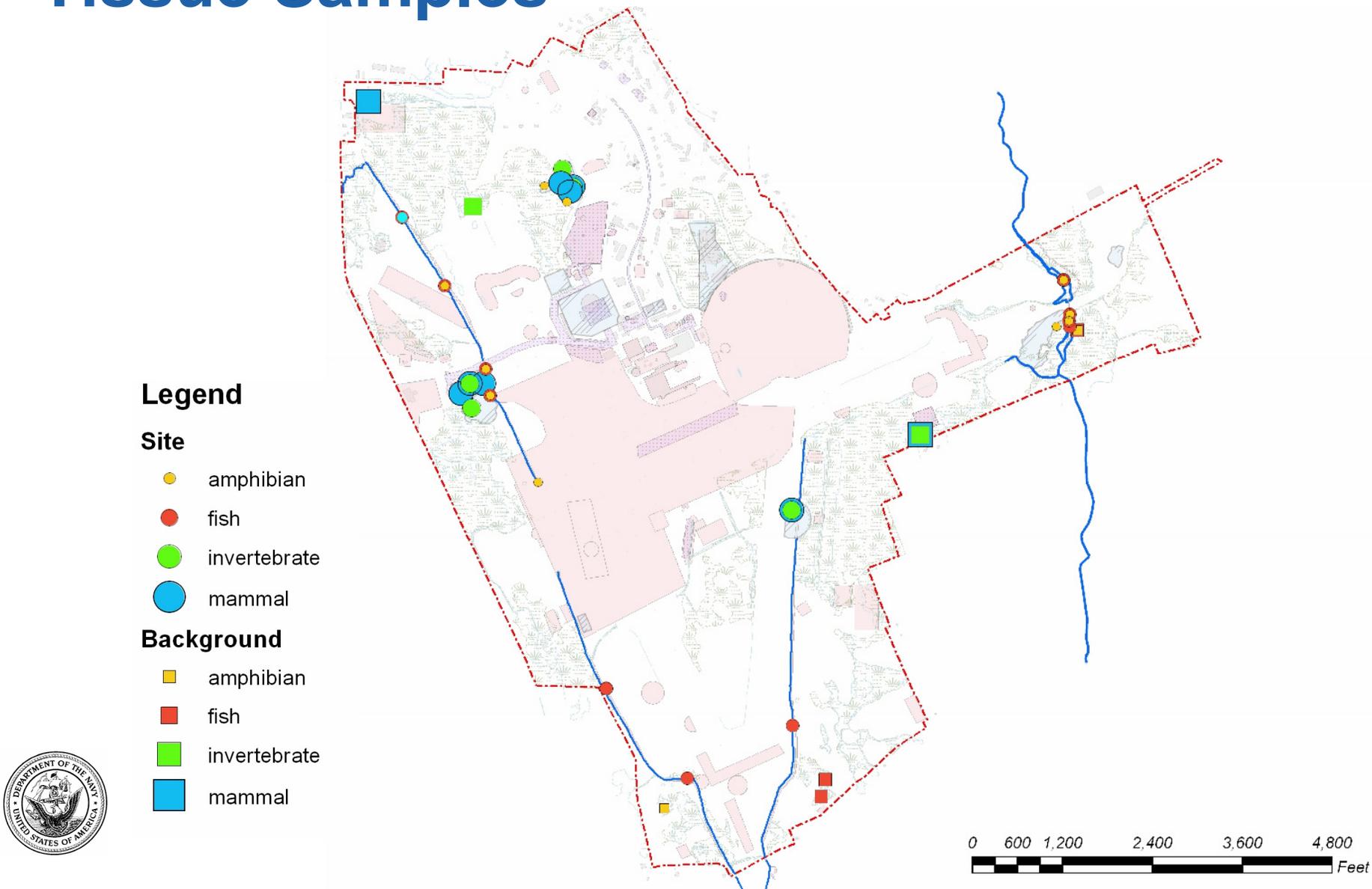
- Background Soil Sample
- Site Soil Sample



Surface Water and Sediment Samples



Tissue Samples



Higher Trophic Level ERA Approach

- Consider maximum and average Basewide and background concentrations
- Model potential daily dose for each chemical and receptor
 - ❖ Ingestion of prey items, drinking water, and sediment or soil
- Compare potential daily dose to Toxicity Reference Value
 - ❖ No adverse observed effect levels
- Hazard quotient = Potential Daily Dose/TRV
 - ❖ HQs < 1 - exposure to a chemical would not be associated with adverse effects
 - ❖ HQs >1 - potential for adverse effects to a receptor due to exposure to a chemical



Higher Trophic Level ERA Results

- Of the 18 bioaccumulative compounds evaluated 11 had HQs < 1 for all receptors
- Seven compounds had an HQ > 1 for at least one receptor under maximum exposure scenario

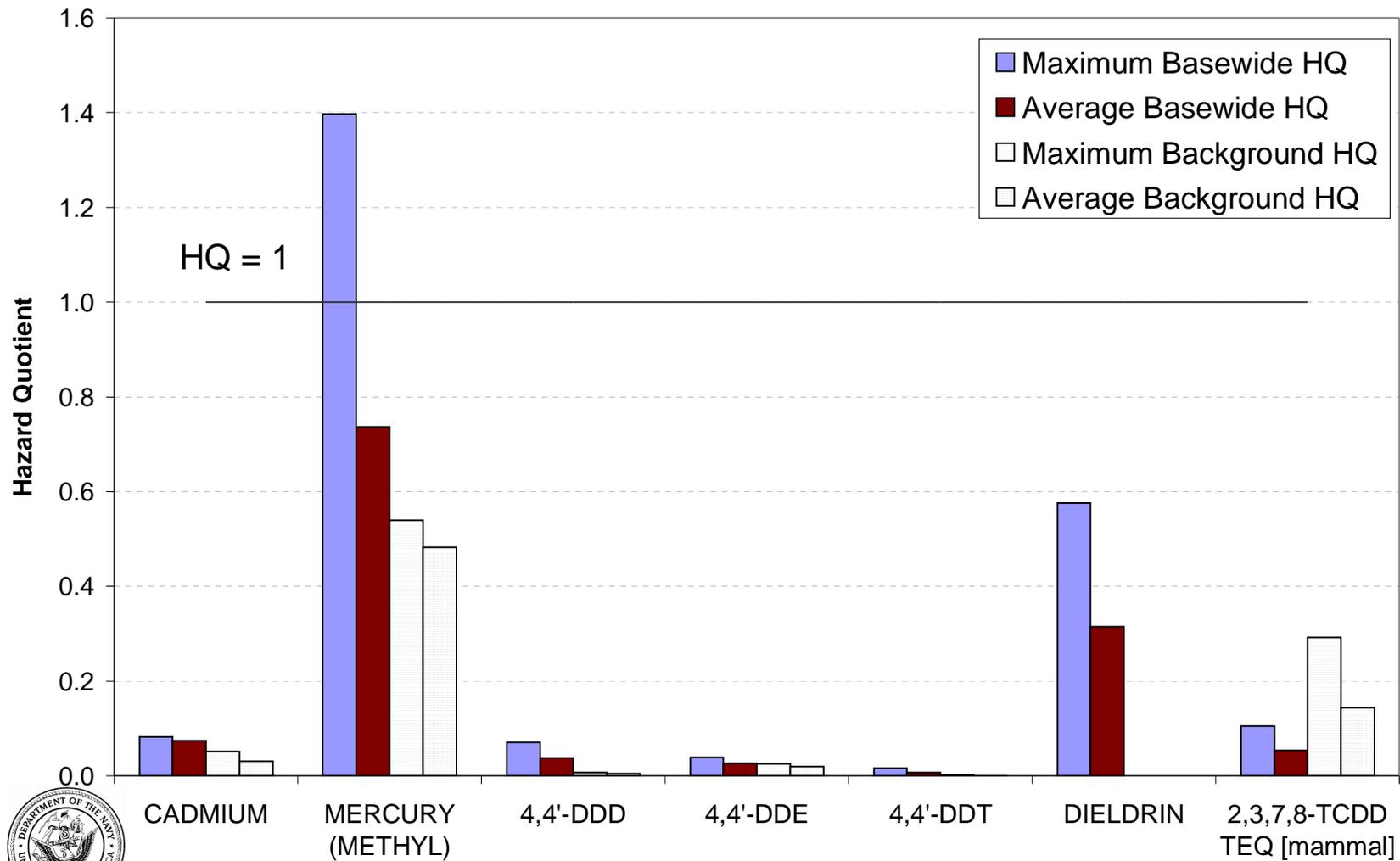
	Hawk	Fox	Coyote	Woodcock	Kingfisher	Raccoon
Cadmium	x	x	x	x		
Methyl mercury					x	x
4,4'-DDD					x	
4,4'-DDE				x	x	
4,4'-DDT				x		
Dieldrin				x		
Dioxins			x			

- Elevated HQs were driven by tissue concentrations
 - not sediment, soil or surface water ingestion
- Elevated HQs were also present at background conditions for some compounds



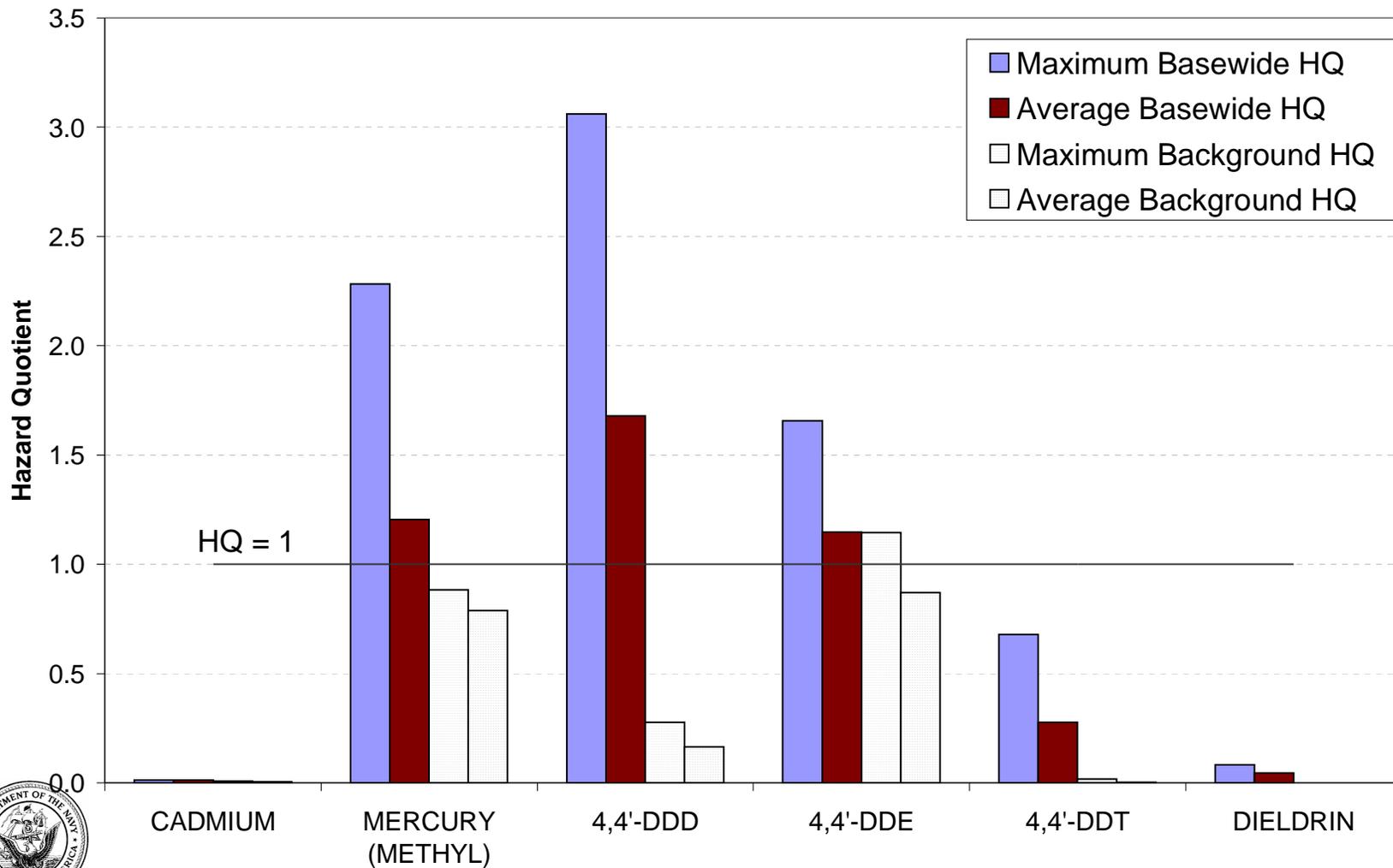
Higher Trophic Level ERA Results

RACCOON



Higher Trophic Level ERA Results

BELTED KINGFISHER



Higher Trophic Level ERA Results

- HQs > 1 were associated with tissues collected primarily from the WGL and STP and in aquatic areas downstream of the RDA
 - ❖ Remedial actions for the WGL and the STP will take place in the near future
 - ❖ RDA has been capped
- Following completion of further remedial actions, tissue concentrations will likely be further reduced resulting in lower HQs



Higher Trophic Level ERA Conclusions

- Highly conservative approach
- HQs > 1 were calculated for seven chemicals
 - ❖ Background HQs > 1 calculated for cadmium and DDE
- HQs likely to decrease with planned remedial actions
- Potential exposure to chemicals in surface soil, sediment, and surface water is not likely to result in significant adverse impacts
- Ingestion of flocculent material is not likely to result in unacceptable risks (HQs well below 1)



Pathway Forward

- Three Draft Technical Memoranda have been submitted to agencies
 - ❖ Geochemical – all agency comments received
 - ❖ Hydrogeological – all agency comments received
 - ❖ Human Health Risk Assessment
- Two Draft Technical Memoranda to be submitted in August 2007
 - ❖ French Stream Ecological Risk Assessment
 - ❖ Higher Trophic Level Ecological Risk Assessment
- Navy is awaiting final agency comments on risk assessments
- Revisions to Technical Memoranda to be prepared following receipt of all comments

