Overview of the Estuary Partnership's Ecosystem Monitoring Program Synthesis

Science Work Group January 2012

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Lower Columbia River Estuary Partnership

Estuary Partnership

- The lower Columbia River is an National Estuary Program, one of only 28 in the nation, authorized by Congress in 1987 amendments to Clean Water Act, § 320

- Established in 1995 by the governors of Washington and Oregon and EPA
  - Lack of focus on the lower river and estuary
  - Bi State findings documented degradation of lower river

- Partners, incl. federal, state, and local governments; universities; non-profits; industry, etc, participate in the development and implementation of a *Comprehensive Conservation and Management Plan (Management Plan)*

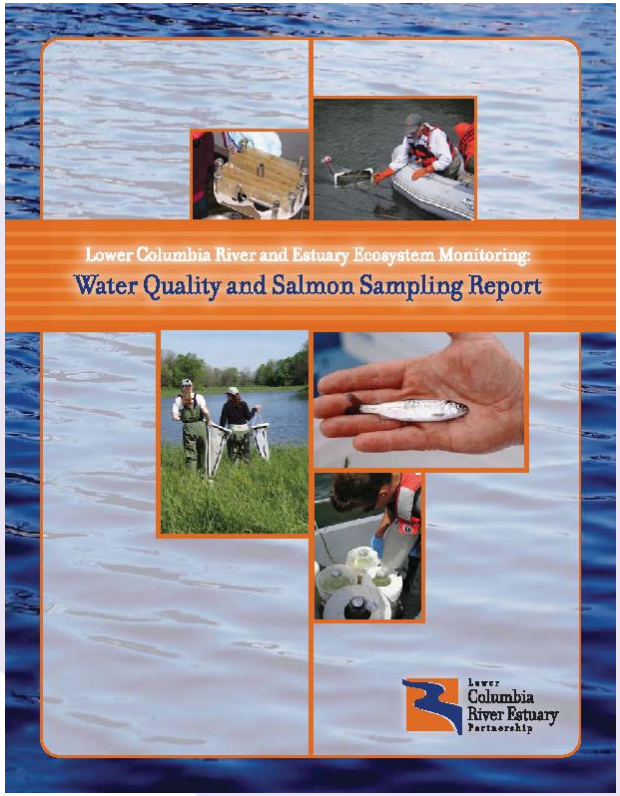
- Estuary Partnership developed a long-term aquatic monitoring strategy for the lower Columbia River in 1999 and this strategy is implemented with our Ecosystem Monitoring Program

Importance of Ecosystem Monitoring Program

- Only comprehensive assessment of juvenile salmonid habitat in Columbia River estuary (combined look at food web, fish usage, vegetation and water column conditions at each site)
- Covers multiple 2008 FCRPS BiOp RPAs and Estuary Module RME actions
- Provides juvenile salmonid stock occurrence, condition, diet and residency
- Assesses habitat capacity, opportunity and realized function of estuarine habitats
  - key information for regional restoration strategies and salmon recovery planning

Ecosystem Monitoring Program (EMP)

- Ecosystem Monitoring Program (EMP), 2003 – present
  - Develop Columbia River Estuary Ecosystem Classification (Classification)
  - Address habitat and toxic contaminant monitoring gaps (2005-2006)
  - Designed to address data gaps to improve ecosystem restoration and salmonid recovery planning
- On-going collaboration with UW, PNNL, USGS, and NOAA
- Supported with funding from BPA



EMP Original Design

- In 2004, PNNL developed a statistically robust sampling design to serve as the basis of future site selection (in combination with the Classification).

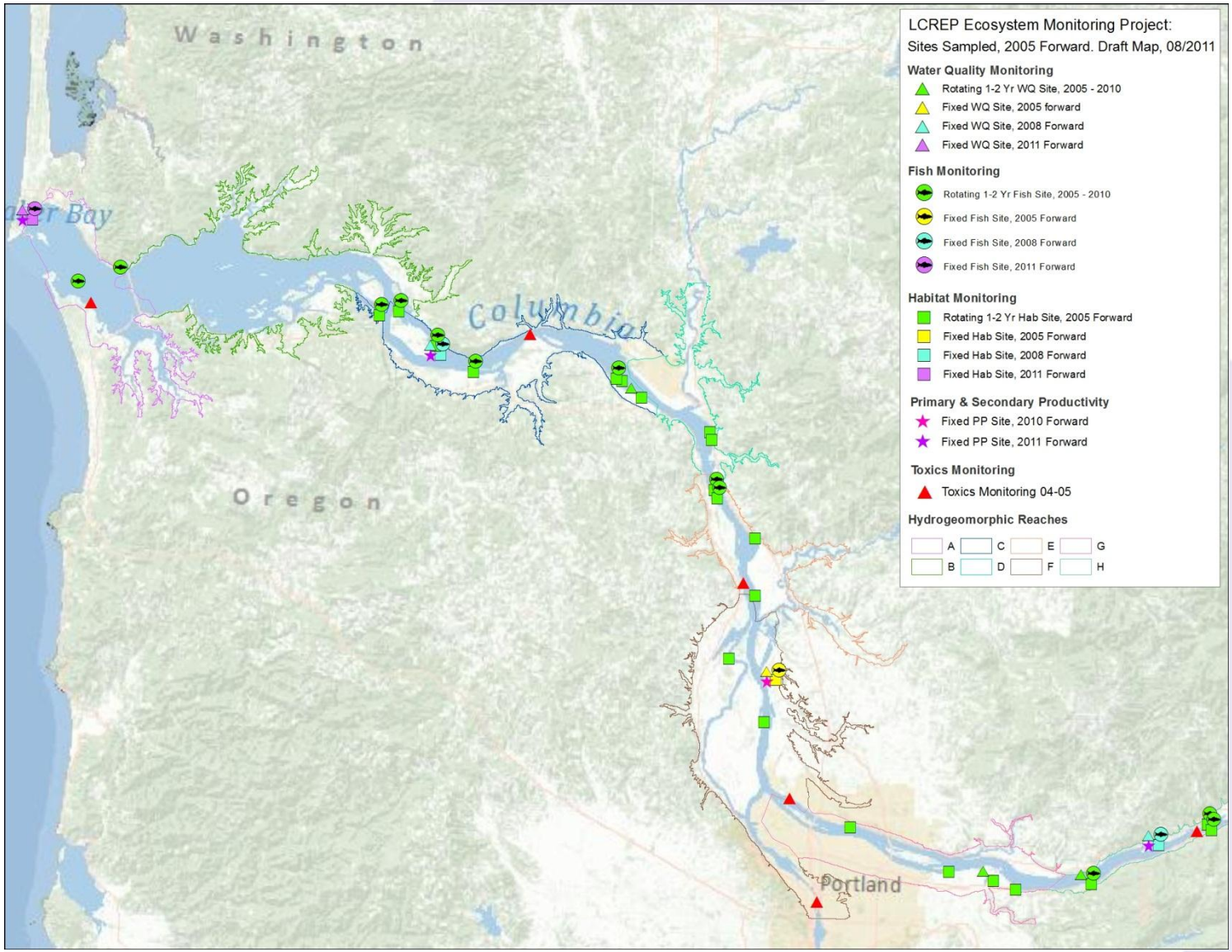
- The design included a two-phased approach:
  - Phase I: Inventory sampling to characterize spatial variability throughout the estuary (approx. 120 sites)
  - Phase II: Long-term trends monitoring to track changes in habitats, and provide information about the effects of restoration actions that can be used to evaluate and refine management measures.
  - Both phases involved a stratified rotational sampling design and incorporated both fixed and randomly selected sites.

- 2005 proposal included 8 fixed sites (1 per reach) with 12 rotating sites

Current EMP Design (2005-2012)

- To date, the implementation of the proposed design has been limited due to cost constraints
- The distinction between phases 1 and then 2 in the original design did not occur
- Estuary Partnership and partners have focused on providing an inventory of habitats (or "status") across the lower river as funding allowed and included a growing number of fixed sites for inter-annual variability (or "trends")
- Since 2007, focus on finishing Classification (w/bathymetry & landcover datasets) to be able to stratify sampling
- Sampling occurs primarily in **relatively undisturbed tidally influenced emergent wetlands** (important rearing habitats for salmon)
  -Growing number of fixed sites (currently 4); 3-4 status sites per year
  -Starting in 2007, fish and vegetation sampling co-located at same sites

EMP Sampling Stratified by Reach



Status Sites

STATUS SITES										
Dataset		**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**Total Sites**
Vegetation	Year			2009, 2010	2005	2007	2005, 2011	2006	2008	
	Number			6	3	4	5	4	3	25
	Sites			Ryan Is	Cottonwood Is. Sm Sl	Sandy Is. 1, 2	Sauvie Cove ('05)	Water RC	Sand Is.	
				Lord-Walker 1, 2	Cottonwood Is. Sl	Lewis R. Mouth	Hogan Ranch ('05)	McGuire Is.	Beacon Rock	
				Wallace Is west ('10)	Dibble Slough	Martin Is.	Deer Is ('11)	Old Chan. Sandy R.	Hardy Slough	
				Jackson Is ('10)			Goat Is ('11)	Chattam Is.		
				Bradwood Landing ('10)			Burke Is ('11)			
Salmon	Year			2009		2007	2011		2008	
	Number			5		1	3		3	12
	Sites			Ryan Is		Sandy Is. 1, 2	Deer Is ('11)		Same as veg	
				Lord-Walker 1			Goat Is ('11)			
				Wallace Is west ('10)			Burke Is ('11)			
				Jackson Is ('10)						
				Bradwood Landing ('10)						
Prey	Year			2009		2007	2011		2008	
	Number			5		1	3		3	12
	Sites			Same as salmon		Same as salmon	Same as salmon		Same as veg	
Basic WQ	Year			2009	2005		2005	2006	2008	
	Number			1	1			1	1	4
	Site			White Island	Dibble Slough			Old Chan. Sandy R.	Sand Is.	

Fixed Sites

Trend Sites

Dataset		A	B	C	D	E	F	G	H	Total Sites
Vegetation	Year	2011, 2012	2012	2009, 2010, 2011, 2012			2005-2011		2008, 2009, 2011, 2012	
	Number	1	2	1			2		1	7
	Sites	Ilwaco		White Is			Campbell Sl		Franz Lake	
							Cunningham Lake			
Salmon	Year	2011, 2012	2012	2009, 2010, 2011, 2012			2007-2011		2008, 2009, 2011, 2012	
	Number	1	2	1			1		1	6
	Sites	Ilwaco		White Is			Campbell Sl		Franz Lake	
Prey	Year	2011, 2012	2012	2009, 2010, 2011, 2012			2007-2010		2008, 2009, 2011, 2012	
	Number	1	2	1			1		1	6
	Sites	Ilwaco		White Is			Same as salmon		Franz Lake	
Basic WQ	Year	2011, 2012	2012	2011, 2012			2006, 2008-2011		2011, 2012	
	Number	1	2	1			1		1	6
	Site	Ilwaco		White Is			Campbell Sl		Franz Lake	
Prim Prod	Year	2011, 2012	2012	2011, 2012			2010, 2011, 2012		2011, 2012	
	Number	1	2	1			1		1	6
	Site	Ilwaco		White Is			Campbell Slough		Franz Lake	
Sec Prod	Year	2011, 2012	2012	2011, 2012			2011, 2012		2011, 2012	
	Number	1	2	1			1		1	6
	Site	Ilwaco		White Is			Campbell Slough		Franz Lake	

Habitat, salmon, salmon prey and water conditions sampling

Vegetation monitoring

- Sampling during peak biomass (July/August), one day per site
- Metrics include: % cover along transects, dominant species, vegetation elevation, water level elevation, sediment grain size, water temperature

Water conditions

- Continuous water quality sampling at fixed sites April through July
- Metrics include: temperature, dissolved oxygen, pH
- Temperature data collected during fish sampling

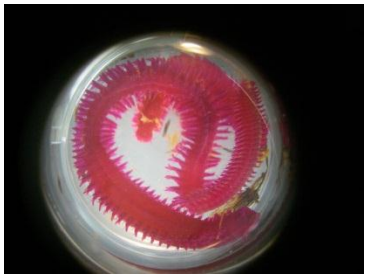
Fish sampling

- Monthly sampling between April and September
- Metrics include: species richness, abundance, CPUE, stock id, length, weight, stomach contents, otoliths for growth rates, marked/unmarked, condition, contaminants

Fish prey (macroinvertebrate)sampling

- Monthly sampling with fish sampling, but gut contents and prey availability taken only when Chinook salmon are caught
- Metrics include: taxonomy, abundance, biomass, terrestrial vs aquatic origin

Food Web Characteristics



LOBO (Land Ocean Biogeochemical Observatory) Platform (2012)

-Expand the existing CMOP network of continuous monitoring stations in the Columbia River estuary

-Biogeochemical monitoring of the lower Columbia River above the influence of the Willamette River

-Metrics include: Wet Labs WQM (temperature, conductivity, chlorophyll a fluorescence, and dissolved oxygen), a Wet Labs CDOM fluorometer (colored dissolved organic matter), a Satlantic SUNA (nitrate and nitrite), and a Wet Labs Cycle-P (dissolved ortho-phosphate)

Zooplankton and phytoplankton sampling (2011/2012)

-Zooplankton, phytoplankton and sediment core prey samples collected between April and July at the six fixed sites

-Metrics include: biomass and net productivity of phytoplankton and periphyton, stable-isotope analysis for plant, plankton, invertebrate and fish tissue, species composition, abundance of sediment core invertebrates

-Winter macrophyte biomass slough off for net export of macrodetritus

Current EMP Goals and Objectives

- To comprehensively assess habitat, fish, food web, and abiotic conditions in the lower river, focusing on shallow water and vegetated habitats used extensively by juvenile salmonids for rearing and refugia

- Conduct long term status and trends monitoring of the biological, physical, and chemical characteristics of estuarine habitats and the opportunity, capacity and realized function they provide juvenile salmonids.

…In order to close data gaps and inform further restoration strategies

EMP Synthesis

Comprehensive data analysis and reporting of all habitat, fish, fish prey, and abiotic water conditions data since 2005 (through 2010)

- Evaluate spatial and temporal variability in habitat, fish, fish prey and water quality

- Provide baseline data on relatively undisturbed tidally influenced wetlands in the lower Columbia River estuary

- Preliminary status and trends information for the lower Columbia River estuary

- Explore relationships between each individual disciplines (fish, fish prey, water conditions, vegetation) to begin to explain patterns

- Technical Report and published material

New monitoring design

Why change the sampling design of the EMP?

- Columbia River Estuary Ecosystem Classification [CREEC] finishes
- More statistically robust true rotational panel based design
- Request from BPA and the Council for Estuary Index and EPA for indicators
- After 5-year synthesis, re-evaluation of goals and objectives; adaptive management

Steps to Designing the Monitoring Program

- Determine goal, objective, actions and assessment questions of interest to resource managers (*SWG meeting*)
- Identify candidate indicators for each assessment question. (*SWG, April 4-5 workshop of key RME investigators, other working groups for specific indicator portfolio, e.g., indicator species*)
- Determine relevance of indicators to both assessment questions and to ecological structure/function using screening criteria (*SWG, April 4-5 workshop of key RME investigators*)
- Determine which are core indicators and provide rationale for each (*SWG and April workshop*)

Steps to Designing the Monitoring Program

- Determine population of interest (using Classification) for each core indicator and minimum number of sites (*SWG, Indicator Steering Committee*)
- Determine what specifically we measure (metrics), frequency of sampling and sampling period (*SWG, Indicator Steering Committee*)
- Establish analysis methods, quality control and data management (*SWG, Indicator Steering Committee*)

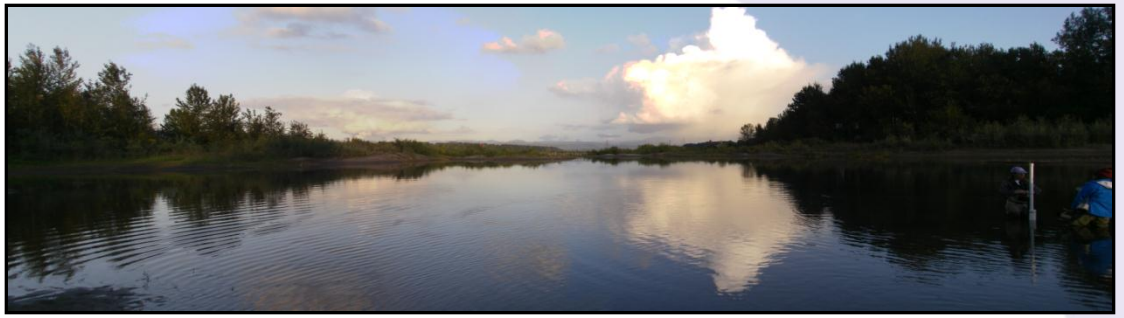
Steps to Designing the Monitoring Program

- Match available funding and projects to list of core indicators (*SWG, Indicator Steering Committee*)
- Test each indicator for variability (temporal- within season and year, inter-annual, spatial) (*SWG, Indicator Steering Committee*)
- Determine thresholds for indicators (*SWG, Indicator Steering Committee*)

Human and program dimension portfolios of indicators will be developed by Board of Directors and Science to Policy workshop in 2013.

Candidate Indicators

- Clearly relate to ecological components or processes deemed important in ecological condition
- Relevant to societal concerns about ecological condition
- Pertain to one or more assessment questions
- An indicator should exhibit significantly different responses at distinct points along a condition gradient and be stable (i.e. low spatial and temporal variability) (EPA, 2000)
- Provide information useful for management decisions
- Feasibility and practicality of implementation-methods, logistics, cost



Candidate Indicators

Does the indicator complement indicators at other scales and levels of biological organization?

The indicator of ecological condition could be a:

- **direct measurement** (dissolved oxygen concentration)
- Or an **index** (benthic condition)

Puget Sound Partnership-Vital Signs Example

Water Quality Index

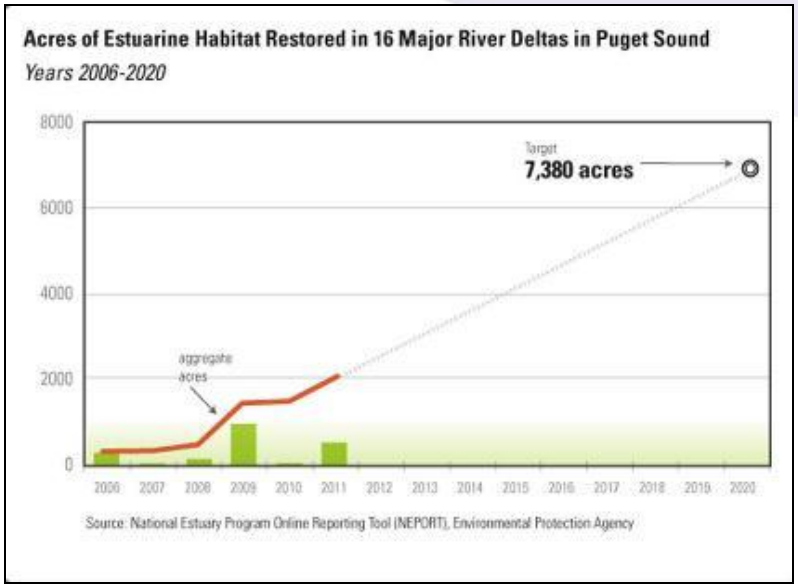
Annual, 2000-2010

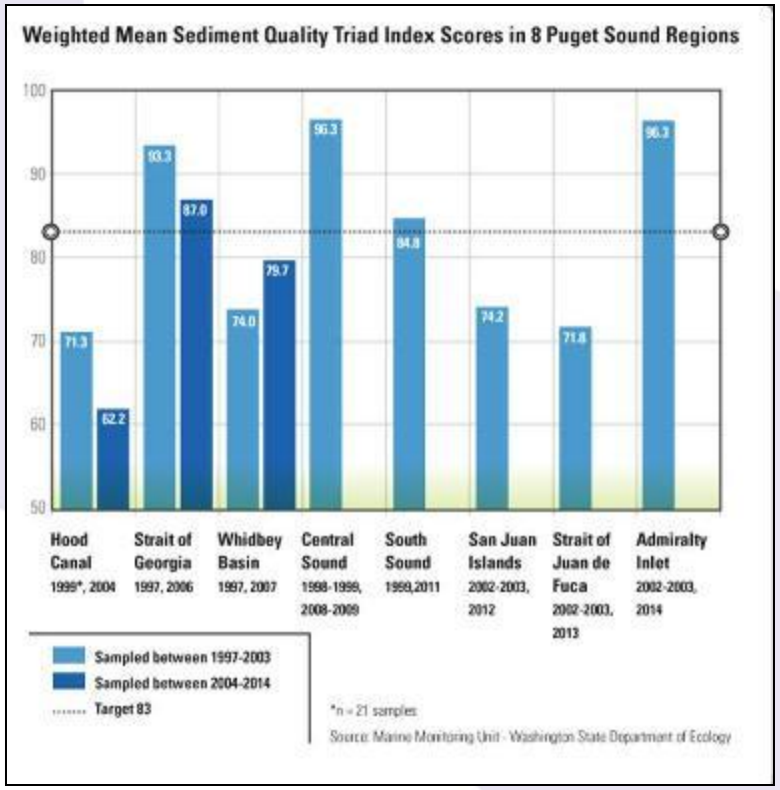
Meeting Goals	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg
Duckabush	93	95	94	90	74	94	89	85	88	96	86	89
Elwha	86	88	83	76	73	74	86	67	66	81	81	78
Skokomish	95	95	94	85	70	67	92	89	89	94	86	87
Snohomish	92	91	89	81	74	75	89	75	81	85	79	83
Borderline	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg
Cedar	87	76	60	78	72	84	81	79	79	81	77	78
Upper Skagit	87	86	59	85	64	81	84	75	75	81	56	76
Lower Skagit	89	91	71	76	61	73	77	77	75	76	74	76
Deschutes	62	72	70	73	61	83	88	88	83	76	74	75
Nisqually	40	60	79	79	69	71	74	75	91	74	83	72
Not Meeting Goals	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg
Green	82	73	66	67	75	49	72	68	60	69	63	68
Nooksack	65	68	58	57	52	54	61	51	60	69	56	59
Puyallup	60	58	57	55	51	58	59	58	61	49	62	57
Samish	86	75	32	49	34	71	67	74	59	80	63	63
Stillaguamish	81	60	44	72	55	67	71	69	75	75	71	67

Source: River and Stream Ambient Monitoring Program, Washington State Department of Ecology

Next Steps Discussion

- Process
- Assessment Questions
- Themes
- Candidate Indicators





Questions?