Effectiveness Monitoring of Brownsville Dam Removal

http://home.netcom.com/~horse/digitarium.html

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http://rivers.bee.oregonstate.edu/index.html

project objectives

- Analyze and propose dam removal monitoring guidance – environmental "experiment designs"
- Document extent, magnitude, and drivers of changes in Calapooia with dam removal
- Provide foundation for long-term projections in Calapooia

change detection and small dam removal

- lack of effect or lack of effective methods?
- Statistical significance - do means mean anything? - Testing hypotheses about probabilities and predictability of geomorphic and biological responses
- Ecological significance – using reliable biotic and abiotic indicators (e.g. responsiveness to disturbance/restoration, feasibility of measurement)

dam removal as environmental experiments

Advantages

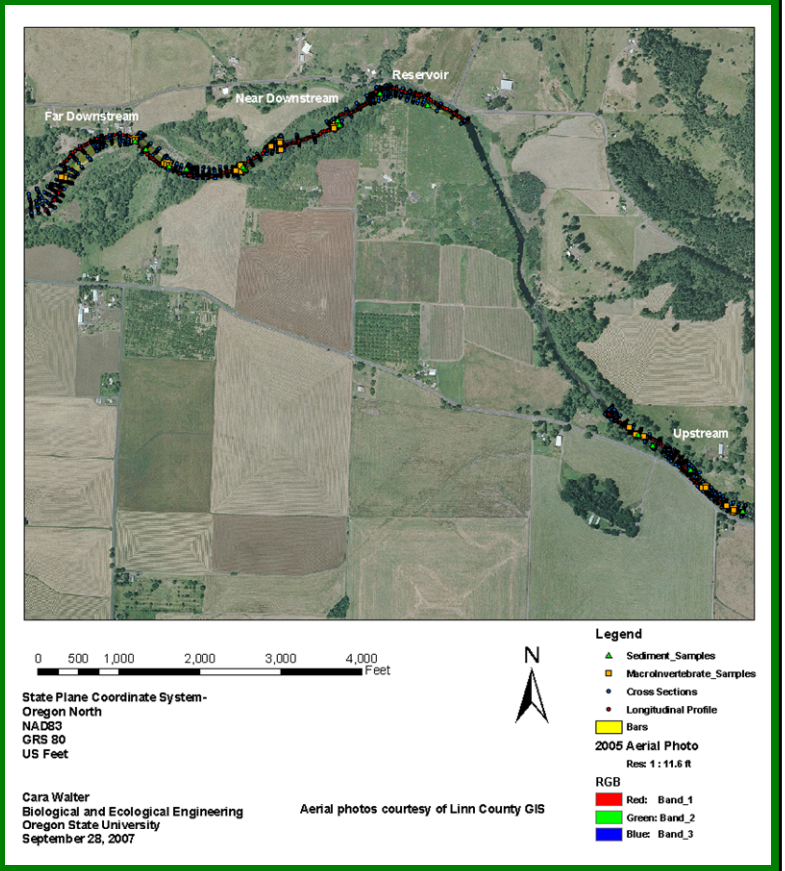
- broad scale trend development
- validation of conceptual and numerical models
- identification of dominant processes and scales
- real-world examples and observations

Disadvantages

- uncontrolled – challenges in hypothesis testing
- spatial and time frames for expectations and recovery are unpredictable
- risk – of wasting money, damaging infrastructure, being wrong…

study layout

- Upstream
- Reservoir
- Downstream1
- Downstream 2



beyond a black BACI box

- BACI – Before-After-Control-Impact
- problems with BACI for environmental experiments
  - US/DS not independent
  - short/absent pre-removal
  - highly background variability
  - unspecific indicators
  - Insufficient sampling

ecological significance – understanding the links

field observations numerical models physical models

the (un)usual suspects

- physical
  - substrate size distribution – bulk samples, pebble counts
  - discharge – historical record extension and gaging
  - bedload and suspended sediment discharge
  - channel geometry, facies/features –total station
- biological
  - coarse vegetation (ODFW)
  - benthic macroinverts (modified EMAP)
  - habitat quality (ODFW)
- socio-economic

the unusual suspects – evidence from invertebrate traits

Hydrologic disturbance

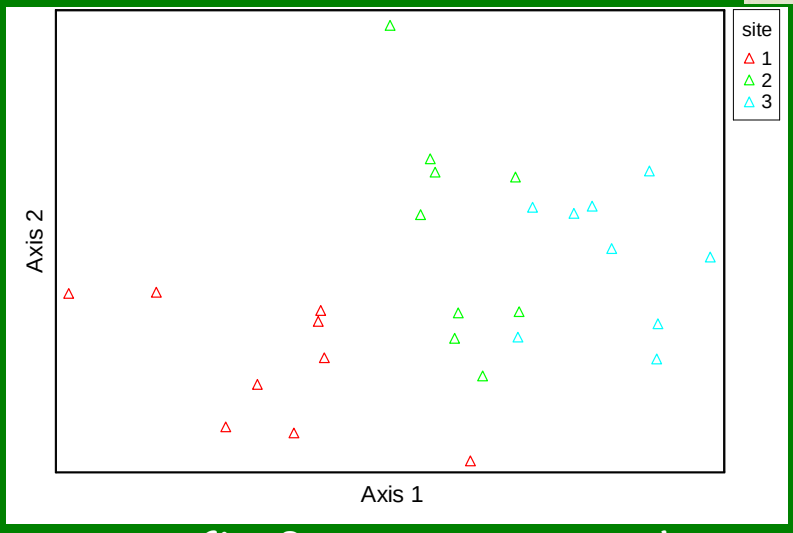
- Reproductive cycle
- Lifespan
- Body size
- Body shape
- Dispersal

restoration disturbance

- Reproductive cycle
- Lifespan
- Development rate
- Adult ability to exit
- Drift
- Habitat and trophic preferences

Tullos et al. (2008)

pre-removal invert traits



Site 3 - upstream control,

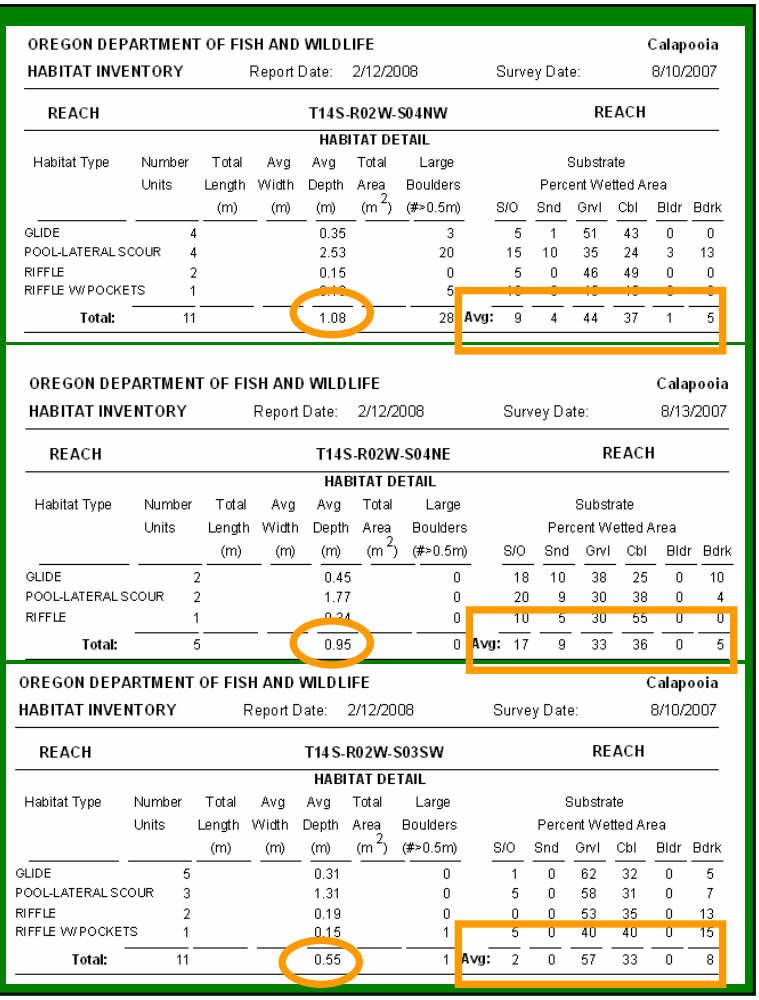
Site 2 - immediately downstream of the dam removal

Site 1 - farthest downstream reach.

pre-removal habitat

relative to watershed?

relative to Willamette Valley?



OREGON DEPARTMENT OF FISH AND WILDLIFE — Calapooia
HABITAT INVENTORY — Report Date: 2/12/2008 — Survey Date: 8/10/2007

REACH — T14S-R02W-S04NW — REACH

HABITAT DETAIL

Habitat Type	Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Large Boulders (#>0.5m)	Substrate Percent Wetted Area S/O	Snd	Grvl	Cbl	Bldr	Bdrk
GLIDE	4			0.35		3	5	1	51	43	0	0
POOL-LATERAL SCOUR	4			2.53		20	15	10	35	24	3	13
RIFFLE	2			0.15		0	5	0	46	49	0	0
RIFFLE W/POCKETS	1			0.13		5	10	0	45	45	0	0
Total:	11			1.08		28	**Avg:** 9	4	44	37	1	5

OREGON DEPARTMENT OF FISH AND WILDLIFE — Calapooia
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HABITAT DETAIL

Habitat Type	Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Large Boulders (#>0.5m)	Substrate Percent Wetted Area S/O	Snd	Grvl	Cbl	Bldr	Bdrk
GLIDE	2			0.45		0	18	10	38	25	0	10
POOL-LATERAL SCOUR	2			1.77		0	20	9	30	38	0	4
RIFFLE	1			0.24		0	10	5	30	55	0	0
Total:	5			0.95		0	**Avg:** 17	9	33	36	0	5

OREGON DEPARTMENT OF FISH AND WILDLIFE — Calapooia
HABITAT INVENTORY — Report Date: 2/12/2008 — Survey Date: 8/10/2007

REACH — T14S-R02W-S03SW — REACH

HABITAT DETAIL

Habitat Type	Number Units	Total Length (m)	Avg Width (m)	Avg Depth (m)	Total Area (m^2)	Large Boulders (#>0.5m)	Substrate Percent Wetted Area S/O	Snd	Grvl	Cbl	Bldr	Bdrk
GLIDE	5			0.31		0	1	0	62	32	0	5
POOL-LATERAL SCOUR	3			1.31		0	5	0	58	31	0	7
RIFFLE	2			0.19		0	0	0	53	35	0	13
RIFFLE W/POCKETS	1			0.15		1	5	0	40	40	0	15
Total:	11			0.55		1	**Avg:** 2	0	57	33	0	8

analysis of methods and responses - sediment sampling

2007 Bulk Samples Summary Table

		D50		D84		D16		D16/D84	
Reach Name	Site Name	subsurface	surface	subsurface	surface	subsurface	surface	subsurface	surface
Upstream Bars	DS Bar	32	27	51	79	7	3.4	7.3	23.2
	US Bar	7	9	102	94	1.9	2.8	53.7	33.6
Upstream Riffles	RI 1	24	22	83	70	3.3	3.3	19.1	30.3
	RI 3	30	40	70	100	2	5	35.0	20.0
Reservoir Bars	RI 1	50	100	80	107	19	39	4.2	2.7
	RI 3	7.2	13	40	43	1.6	1.7	25.0	25.3
Reservoir Excavator	0-2 feet	100	-	103	-	65	-	1.6	-
	2-4 feet	59	-	102	-	19	-	5.4	-
	3-6 feet	59	-	99	-	32	-	3.1	-
	6-8 feet								
Downstream 1 Bars	DS	26	24	100	75	1.7	1.8	58.8	41.7
	US	7.1	5.7	34	70	2.7	1	12.6	70.0
Downstream 1 Riffles	RI 1	21	28	71	101	3	3.5	23.7	28.9
	RI 3	24	23	58	73	4.5	5	12.9	14.6
Downstream 2 Bars	DS	30	26	52	57	6.5	1.4	8.0	40.7
	US	33	26	87	72	4.5	3.7	19.3	19.5
Downstream 2 Riffles	DS R1	29	24	68	70	7.3	2.3	8.2	28.0
	UP R3	35	67	58	104	8.3	38	7.0	2.7

Informing removal outcomes - sediment transport

Uncertainty and accuracy

- predictive equations
- evacuation rates
- fate of stored sediment

Hydrology of the Calapooia

Kelly Kibler

PhD – Water Resources Engineering

Gauging the Calapooia at Brownsville:
River Discharge (Q)

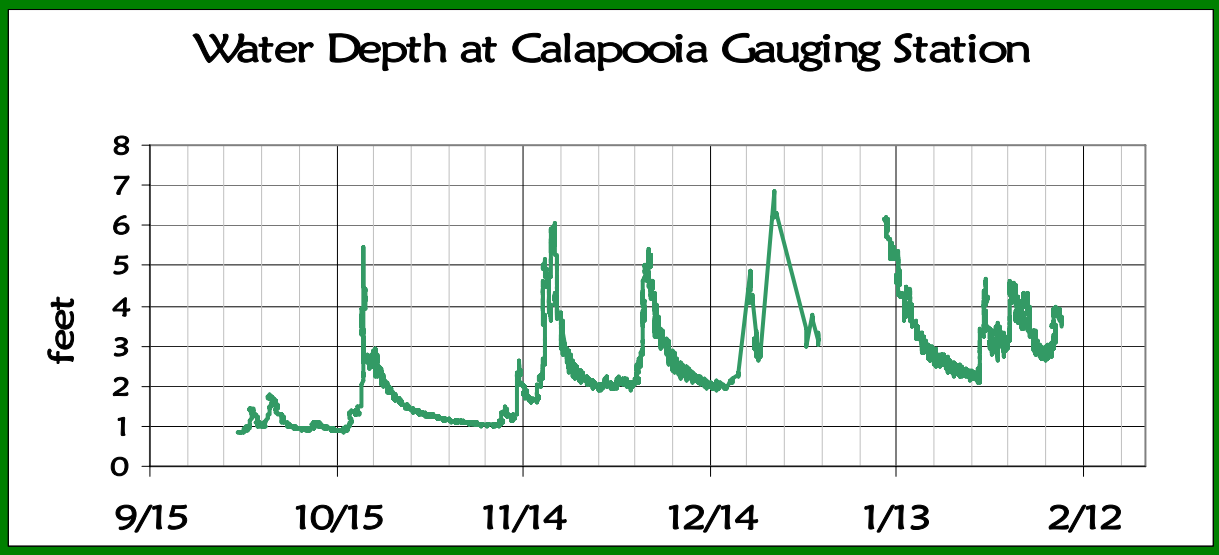
- What is Q?
  - measure of the volume of water that flows past a given point in the river per unit of time
  - units- cubic feet per second (cfs)
- Why measure Q?
  - aquatic habitat
  - sediment transport

Brownsville Gauging Station

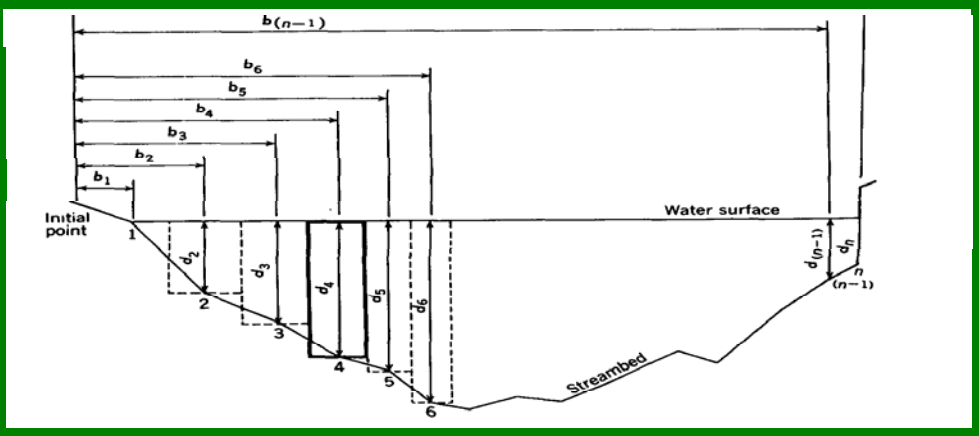
Brownsville Gauging Station

Brownsville Gauging Station

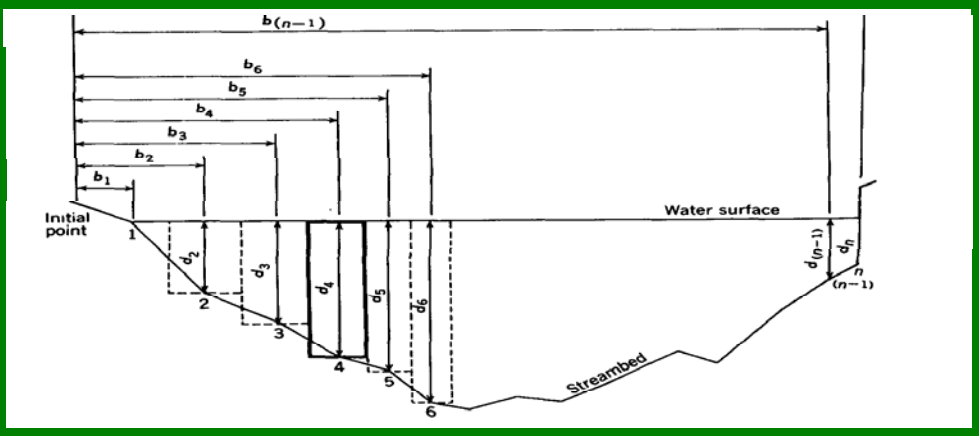
Brownsville Gauging Station



USGS Mid-section method



USGS Mid-section method



Area X velocity = Q

feet^2 X ft/second = cfs

$\sum$Qsection =Qriver

Calapooia at low Q

Easy to wade

Calapooia at high Q-

<u>unsafe</u>

<u>to wade</u>

Calapooia at high Q-

unsafe to wade-
but we can use the bridge.

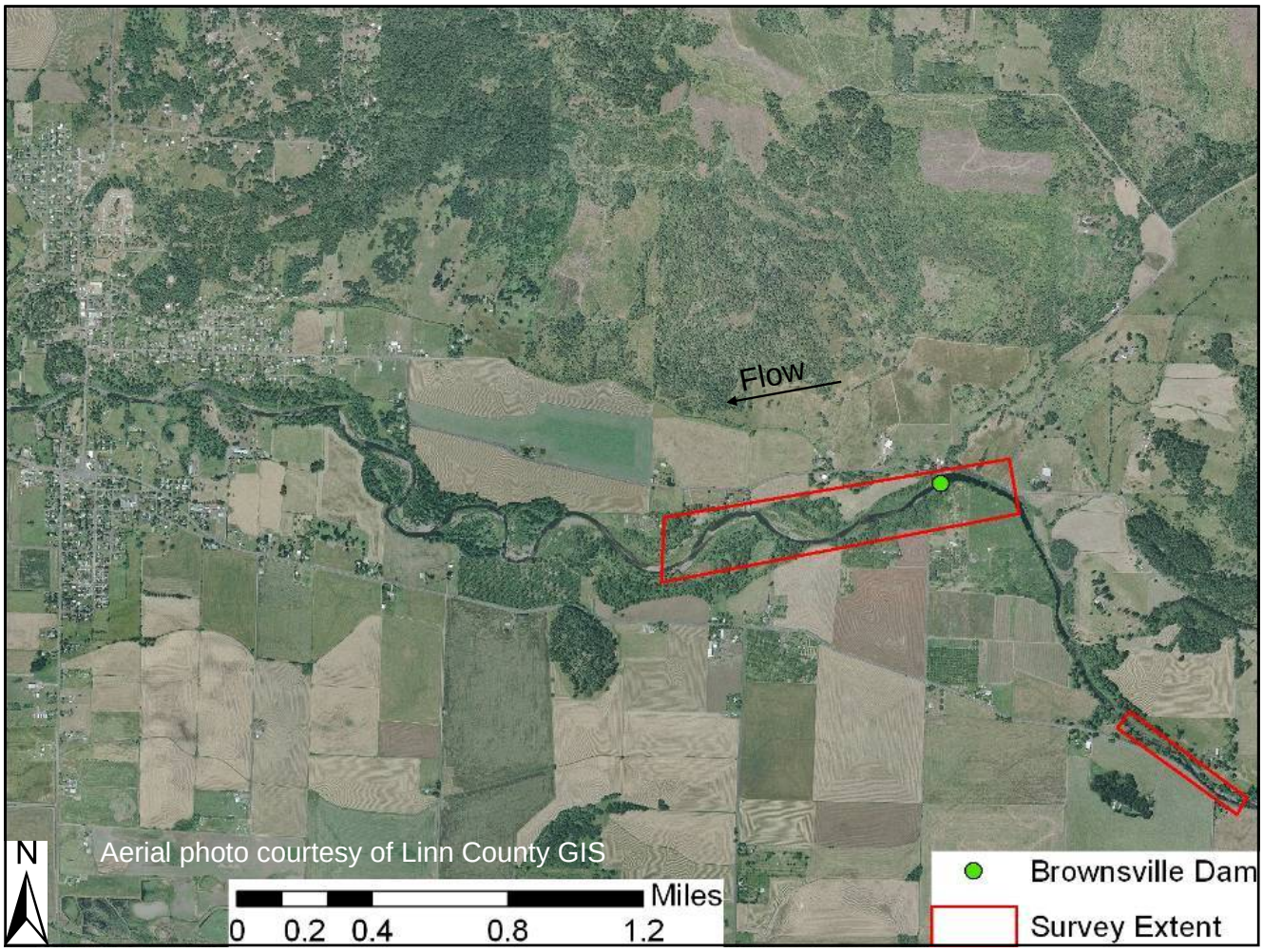
Bridge gauging equipment

Bridge gauging equipment

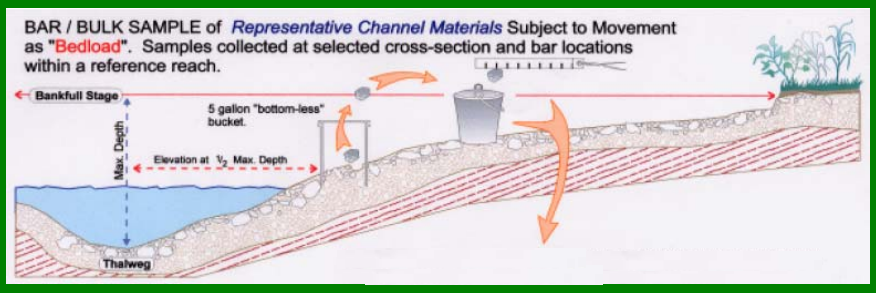
Our plan:
measure Q
once a week

Historical and post-removal channel change

Cara Walter
MS – Water Resources Engineering

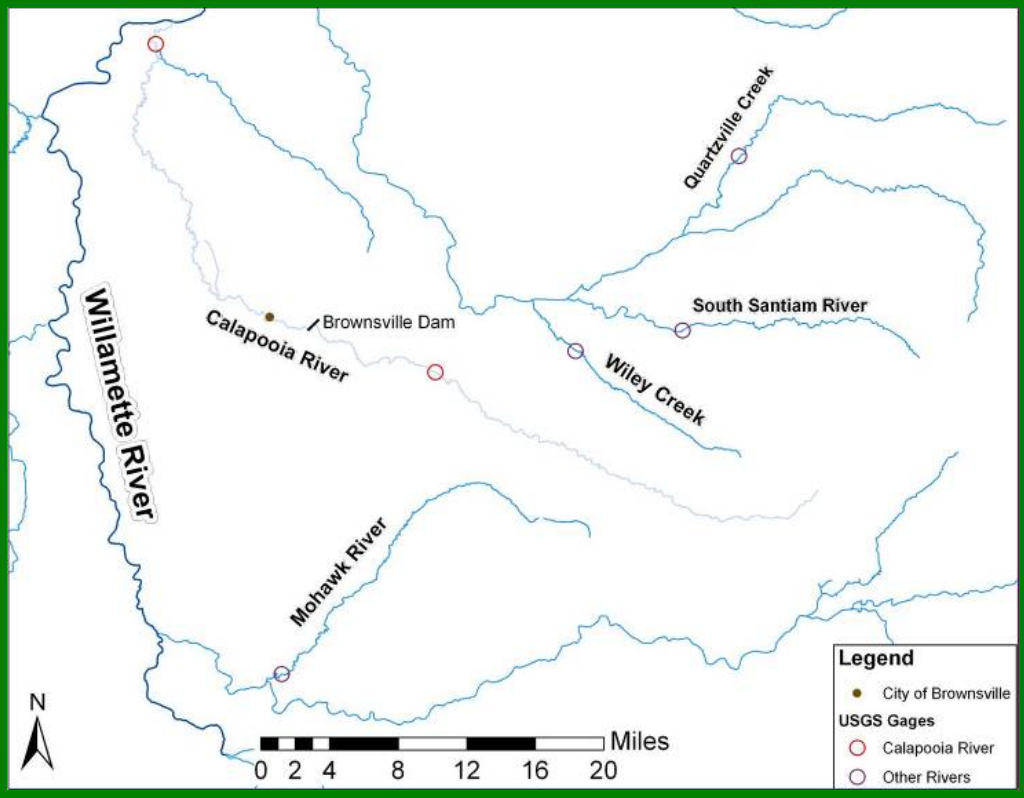

Flow
N
Aerial photo courtesy of Linn County GIS
Miles
0 0.2 0.4 0.8 1.2
Brownsville Dam
Survey Extent

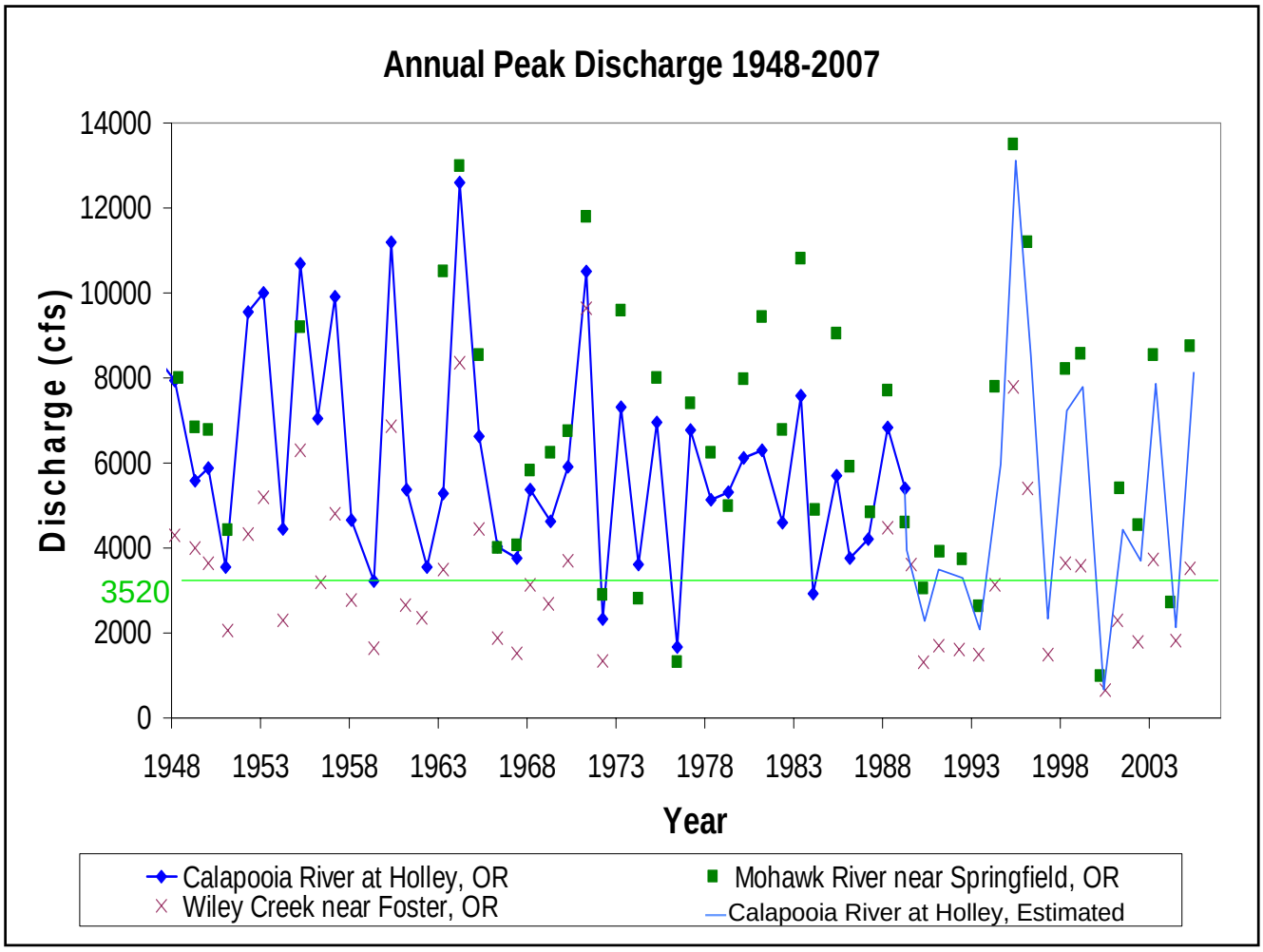
Field Measurements



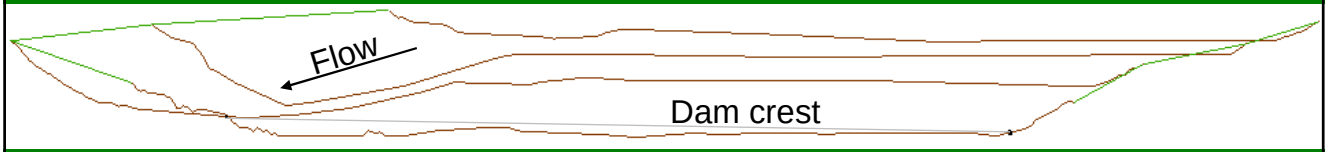

N
Aerial photo courtesy of Linn County GIS
0 500 1,000 2,000 3,000 4,000
Feet
Sediment_Samples
Survey Points

Discharge Comparison




Annual Peak Discharge 1948-2007
Discharge (cfs)
14000
12000
10000
8000
6000
4000
3520
2000
0
1948
1953
1958
1963
1968
1973
1978
1983
1988
1993
1998
2003
Year
Calapooia River at Holley, OR
Wiley Creek near Foster, OR
Mohawk River near Springfield, OR
Calapooia River at Holley, Estimated

Reservoir Channel Changes



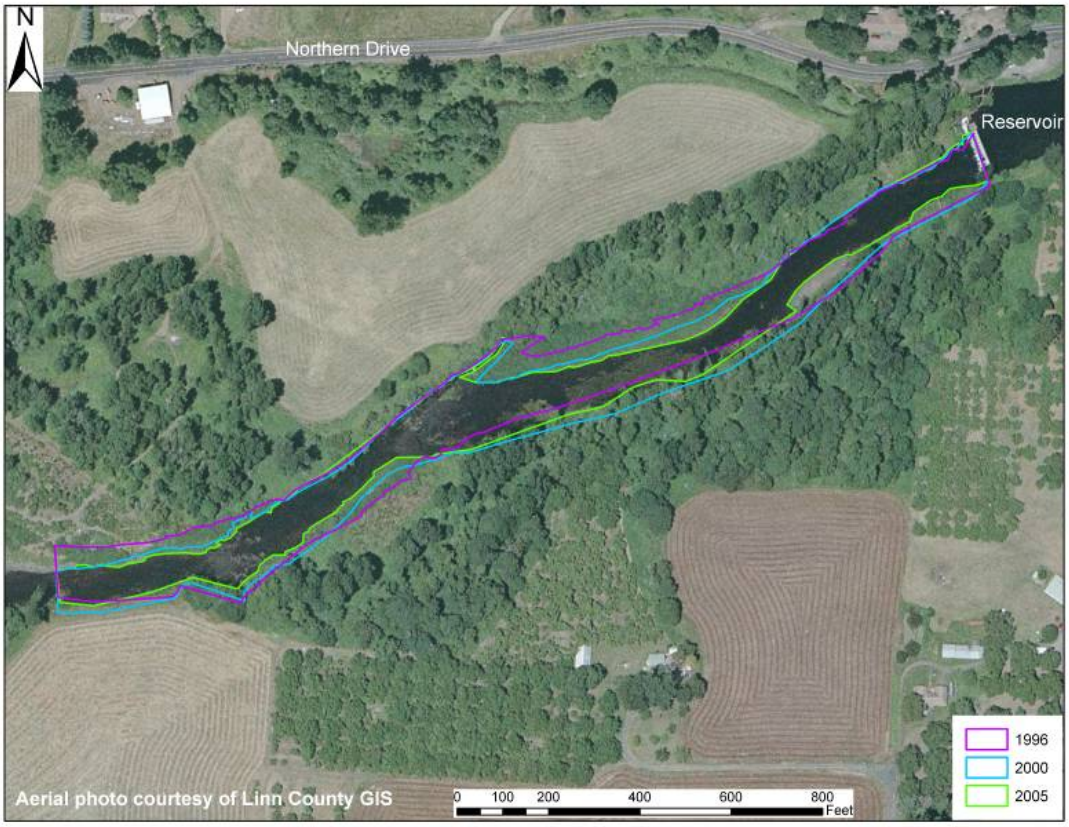

11-07-2007


12-12-2007

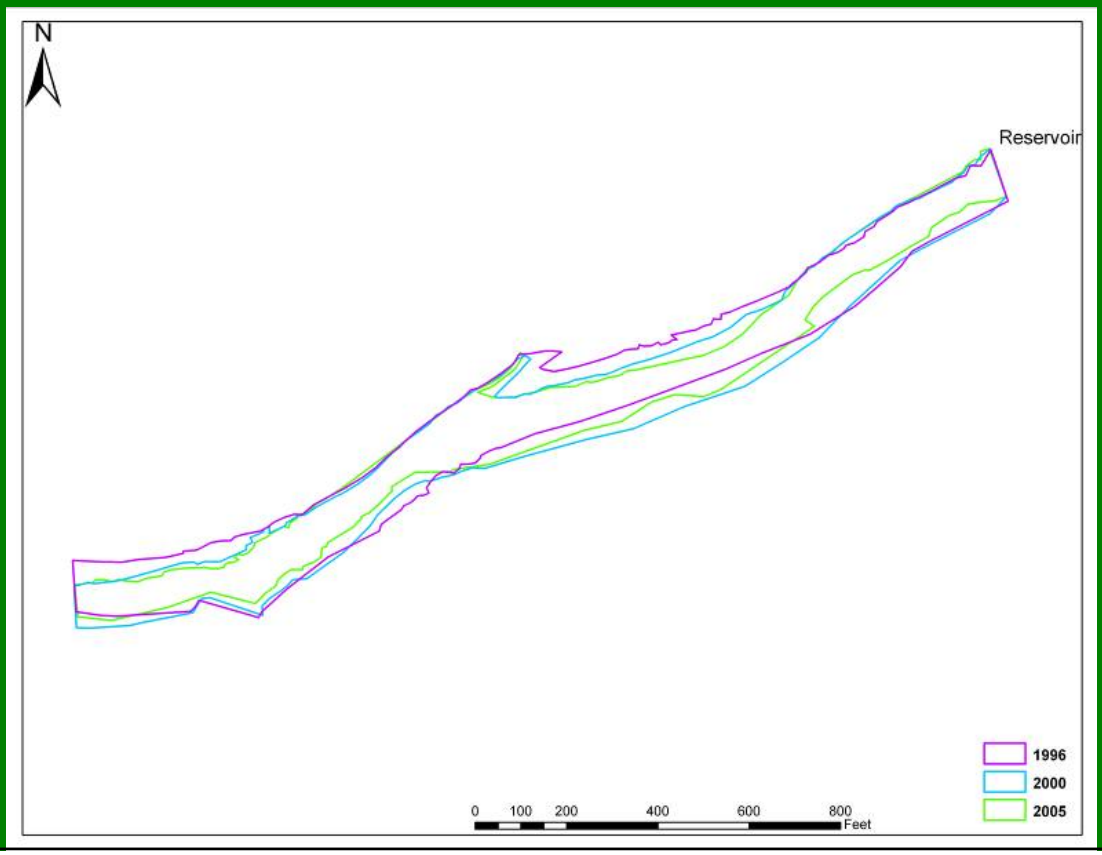

1-11-2008


2-08-2008

Downstream Channel Changes



Downstream Channel Changes




10-08-2007


10-08-2007


11-07-2007


2-08-2008

Socio-economic Impacts of Removal

Denise Elston

MS – Water Resources Science and Policy

Why Brownsville?

- It is one of the first in the nation under the National Oceanic and Atmospheric Administration's new Open Rivers Initiative (ORI)
- Partnerships, working together for healthy streams and community benefits
- Establishes monitoring and provides an opportunity to look at the whole story over a longer period of time

What Makes This Study Important

- Currently, no comprehensive social impact analysis on small dam removal
- The opportunity to design a "template" for other removals
- Learn what makes successful community participation in future dam removals

What is a Social Impact Analysis (SIA)?

- It is "the process of analyzing, monitoring, and managing the intended and unintended consequences, both positive and negative, of planned interventions"

(International Association for Impact Assessment pamphlet, 2006)

Components of Analysis

- Develop a baseline
- Identify appropriate social indicators
- Identify appropriate economic indicators
- Operationalize (measure) the indicators
- Ensure methods and assumptions are transparent and replicable

What are Indicators?

- Variables which are considered in a study to provide information that could be used to determine social impacts that might exist in a particular community.
- A measure of the well-being of society and of its citizen

Potential Impacts of Dam Removal

- Health and Social Well-being
- Quality of the Living Environment
- Economic and Material Well-being
- Cultural Effects
- Family and Community
- Institutional, Legal, Political, and Equality

Health and Social Well-Being Impacts	Quality of the Living Environment (Livability) Impacts	Economic Impacts and Material Well-Being Impacts	Cultural Impacts	Family and Community Impacts	Institutional, Legal, Political, and Equity Impacts
Uncertainty -being unsure of the effects or meaning of dam removal	Leisure and recreational activities and opportunities	Standard/Cost of living	Cultural integrity-degree to which local culture is respected and likely to persist	Changes in social networks	Participation in decision-making
Feeling about the removal that may result in formation of interest groups	Perceived and actual quality of the living environment	Property values-real estate sales	Experience of being culturally marginalized-e.g., structural exclusion of certain groups	Changes in demographic structure of the community	Changes in land ownership, tenure, or legal rights
Annoyance - experiences due to disruption of life	Aesthetic qualities	Replacement costs of environmental services	Loss of cultural or natural heritage- areas of recreational value	Community identification and connection-sense of belonging, attachment to place	Impact equity-distribution of social and economic impacts across the community
Dissatisfaction -due to failure of removal to deliver promised benefits	Perception of personal safety, hazard exposure, and fear of crime	Occupational status and type of employment-temporary local jobs generated by the project	Change in cultural traditions	Perceived and actual community cohesion	Access to and utilization of legal procedures and advice throughout project
(Location for) delinquent behavior		Access to public goods/services		Social differentiation and inequality-creation of perceived or actual differences between groups	
				Changes in social tension-conflict within the community	

Impacts and Indicators

Impact: Economic and Material Well-Being

Indicators: Property values; real estate sales

Example Measurement: Changes in housing prices; changes in numbers of day house on market before sale

Impact: Health and Social Well-Being

Indicator: Uncertainty; being unsure of the effects or meaning of dam removal

Example Measurement: Change in knowledge about dam removal

Impact: Quality of the Living Environment (Livability)

Indicator: Leisure and recreational activities and opportunities

Example: Measurement: Changes in angling types and rates

Impact: Cultural Effects

Indicator: Cultural practices and traditions

Example Measurement: Changes in location of community activities

Impact: Family and Community

Indicator: Social tension and/or conflict within the community

Example Measurement: Changes in number of disagreements in public meetings

Impact: Institutional, Legal, Political, and Equity

Indicator: Participation in decision-making

Example Measurement: Changes in meeting attendance

What Happens Next