Evaluation of Lamprey Behavior at Lower Fishway Sections of Bonneville and John Day dams using DIDSON, 2012

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Portland District Fisheries Field Unit
Bonneville Lock and Dam, Cascade Locks, OR 97014

Background & motivation

- Telemetry studies have identified passage bottlenecks such as fishway entrances
- Desire to develop monitoring methods that do not require capture and handling
- Need information on fish behavior and passage performance at same scale as modifications

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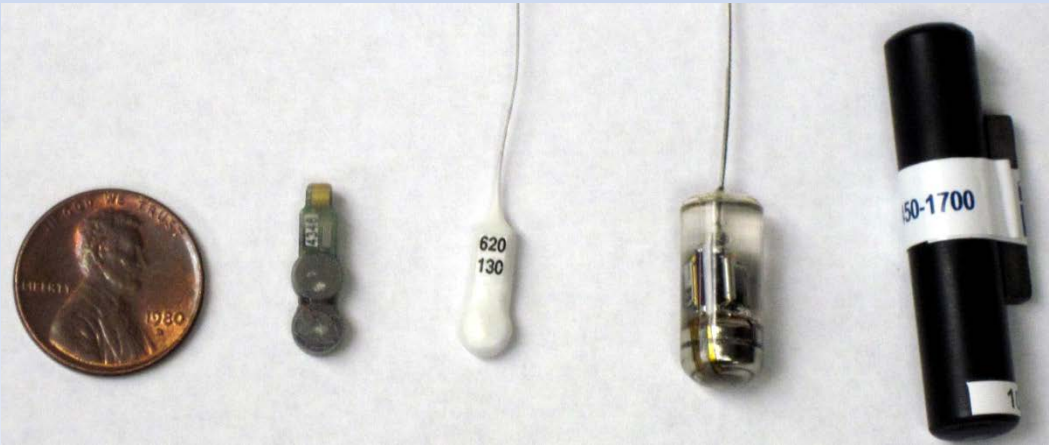
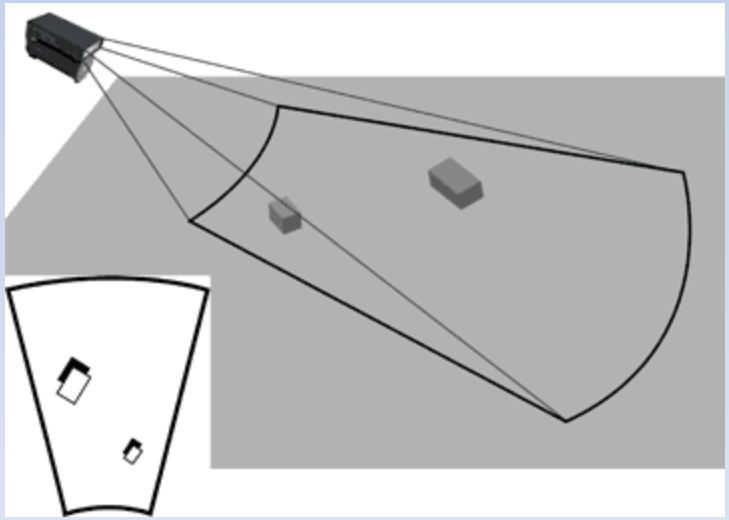
Scale of Monitoring

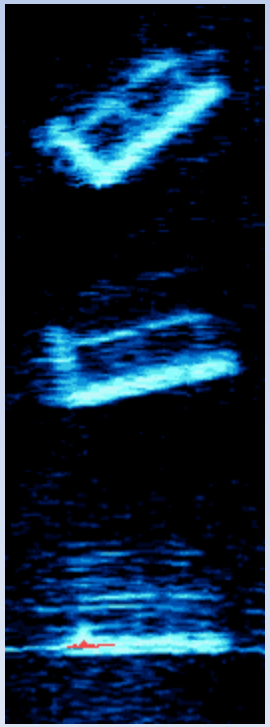
- **Video (Optical/IR Optical)** Visual range of optical/IR video ~ 0.5 – 2 m (microscale)
- **Radio-telemetry** Spatial resolution of radio-telemetry ≥ 10m (macroscale)
- **Acoustic telemetry** Fishways: TBD



Scale of Monitoring: DIDSON

- **Dual frequency IDentification SONar** range ~1-15 m (mesoscale)
- 96 acoustic beams over a 29° field-of-view (each beam 0.3 degrees apart)





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2012 Research Objectives: BON and JDA

- Behavior at Entrances (BON, JDA)
  - Orientation and routes
  - Interactions with attraction plume
  - Pre-mod data (BON);
  - Post-mod bollards (JDA)
- Movement and distribution in collection channels (BON, JDA)
- BON Junction Pool
- JDA North Fishway Transition Pool

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Classification Criteria

- Developed in 2011 Study
- Lamprey, sturgeon, salmonids, shad often discernable
- Criteria for identifying targets as lamprey, scored three confidence levels
  - anguilliform swimming motion (Breder 1926)
  - target shape, including length:width ratio & lack of protruding fins
  - target size of ~50-80 cm
  - other characteristic lamprey behaviors such as attachment to surfaces

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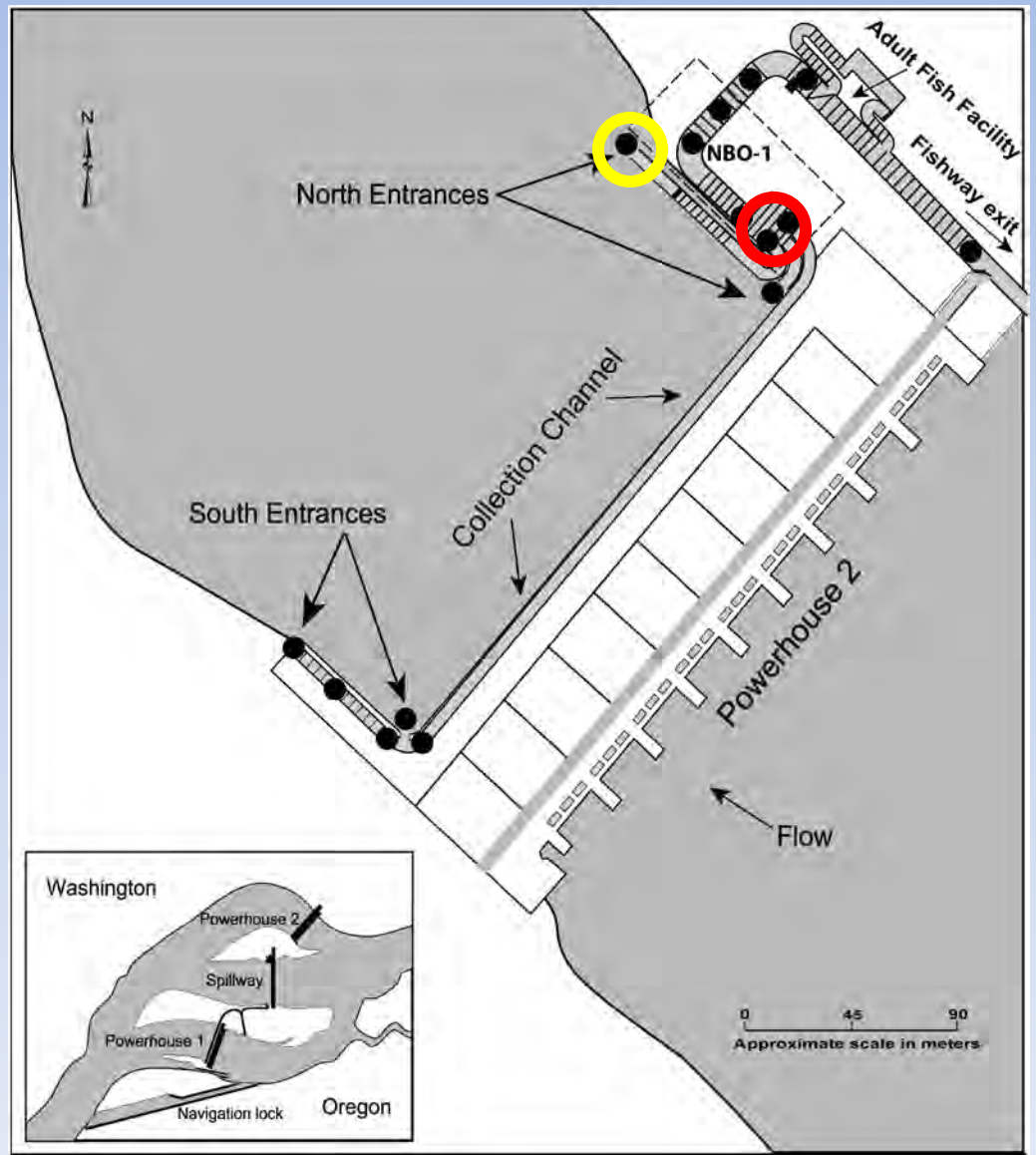
Bonneville DIDSON Study Sites



- PH2 North Entrance
- PH2 Junction Pool

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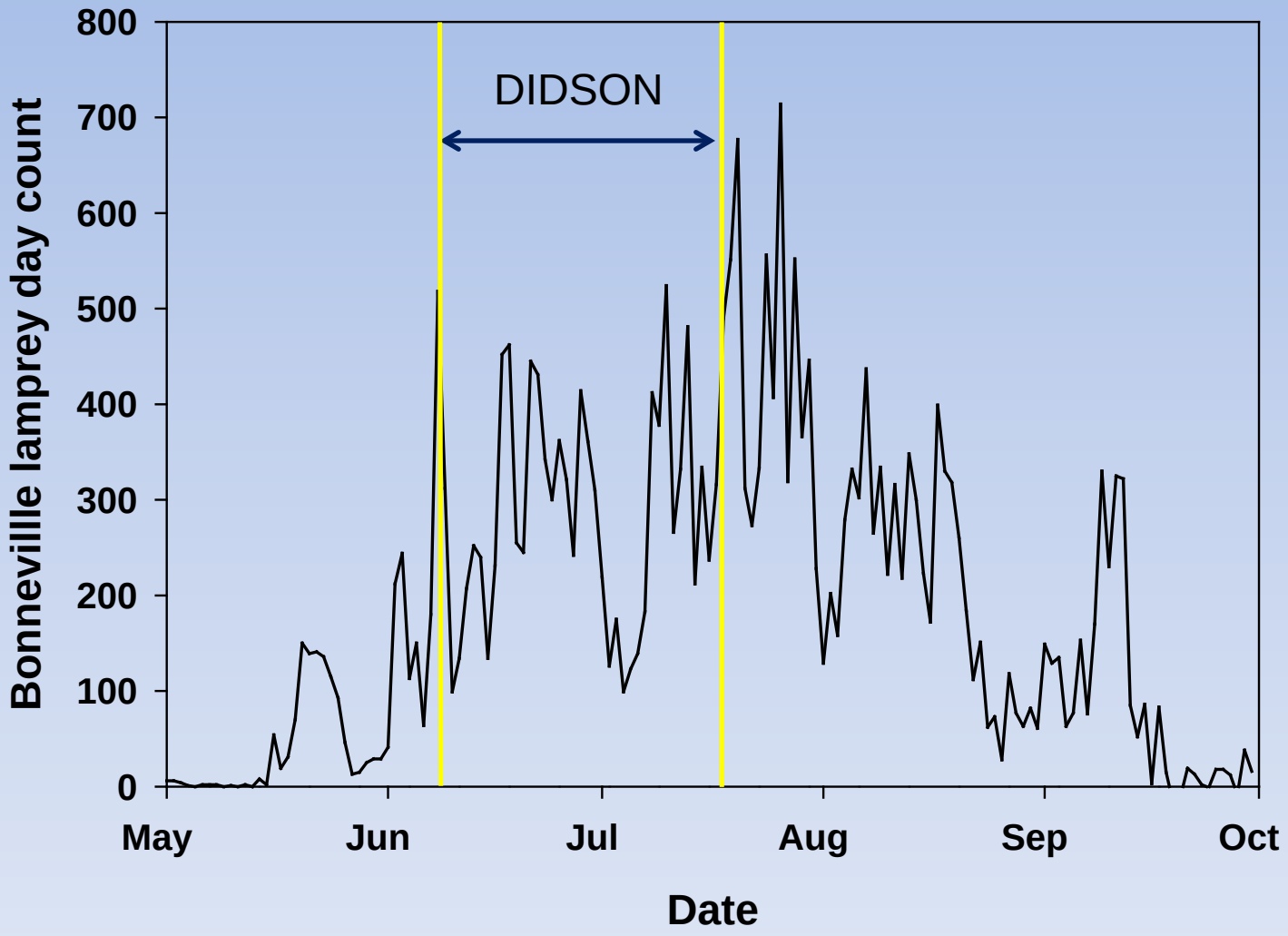
Bonneville DIDSON Deployment



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Analyses to Date

		Data collected (h)				Data watched (h)				Data watched (%)		
Site	Orientation	Day	Night	Total		Day	Night	Total		Day	Night	Total
NDE	Portrait	63	34	97		7	12	19		11.1	35.3	**19.6**
NDE	Landscape	84	51	135		11	20	31		13.1	39.2	**23.0**
JP North	Landscape	143	101	244		18	31	49		12.6	30.7	**20.1**
JP West	Landscape	103	80	183		9	21	30		8.7	26.3	**16.4**

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Analyses to Date

Bonneville Dam	NDE Portrait	NDE Landscape	JP North	JP West
Files watched	108	185	296	197
Hours	19	31	49	30
Events (Total)	397	747	241	637
Events/h	**20.9**	**24.1**	**4.9**	**21.2**
Confidence Class				
Low	10 (3%)	12 (2%)	15 (6%)	18 (3%)
Medium	132 (33%)	122 (16%)	79 (33%)	156 (24%)
High	255 (64%)	613 (82%)	147 (61%)	463 (73%)

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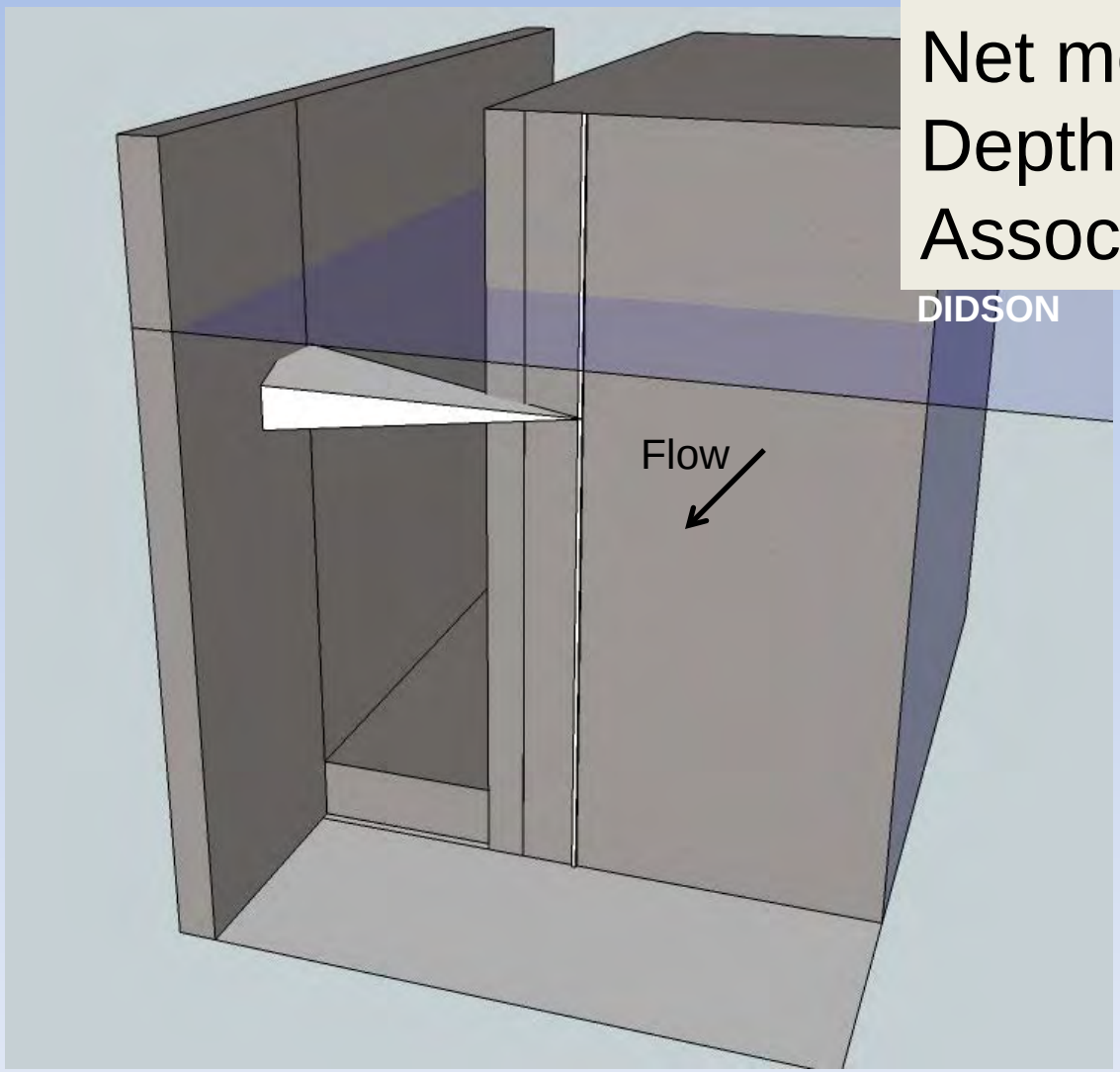
North Downstream Entrance Deployment

Entrance Behaviors?
Net movement?
Depth Distribution?
Association with Sturgeon?



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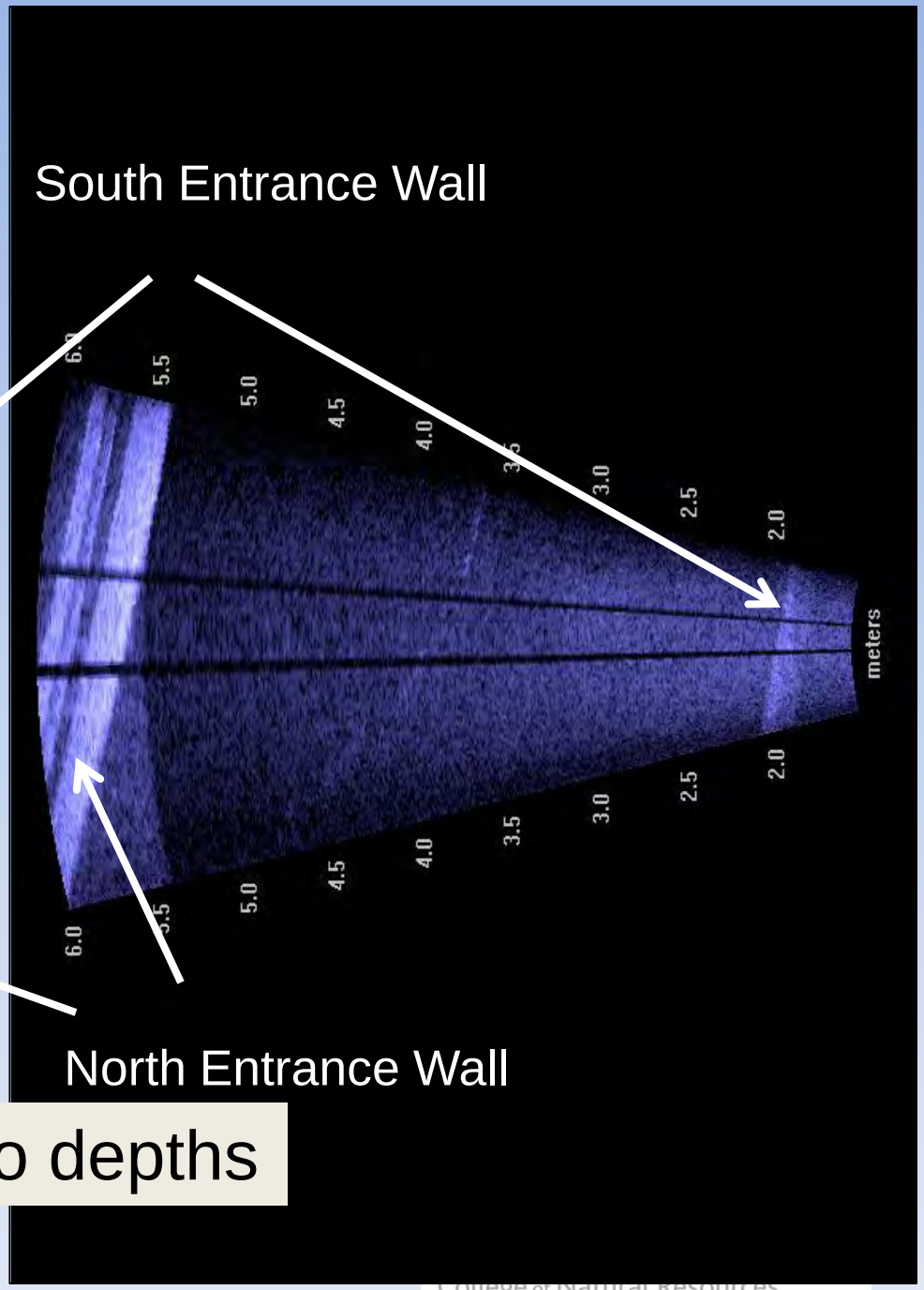
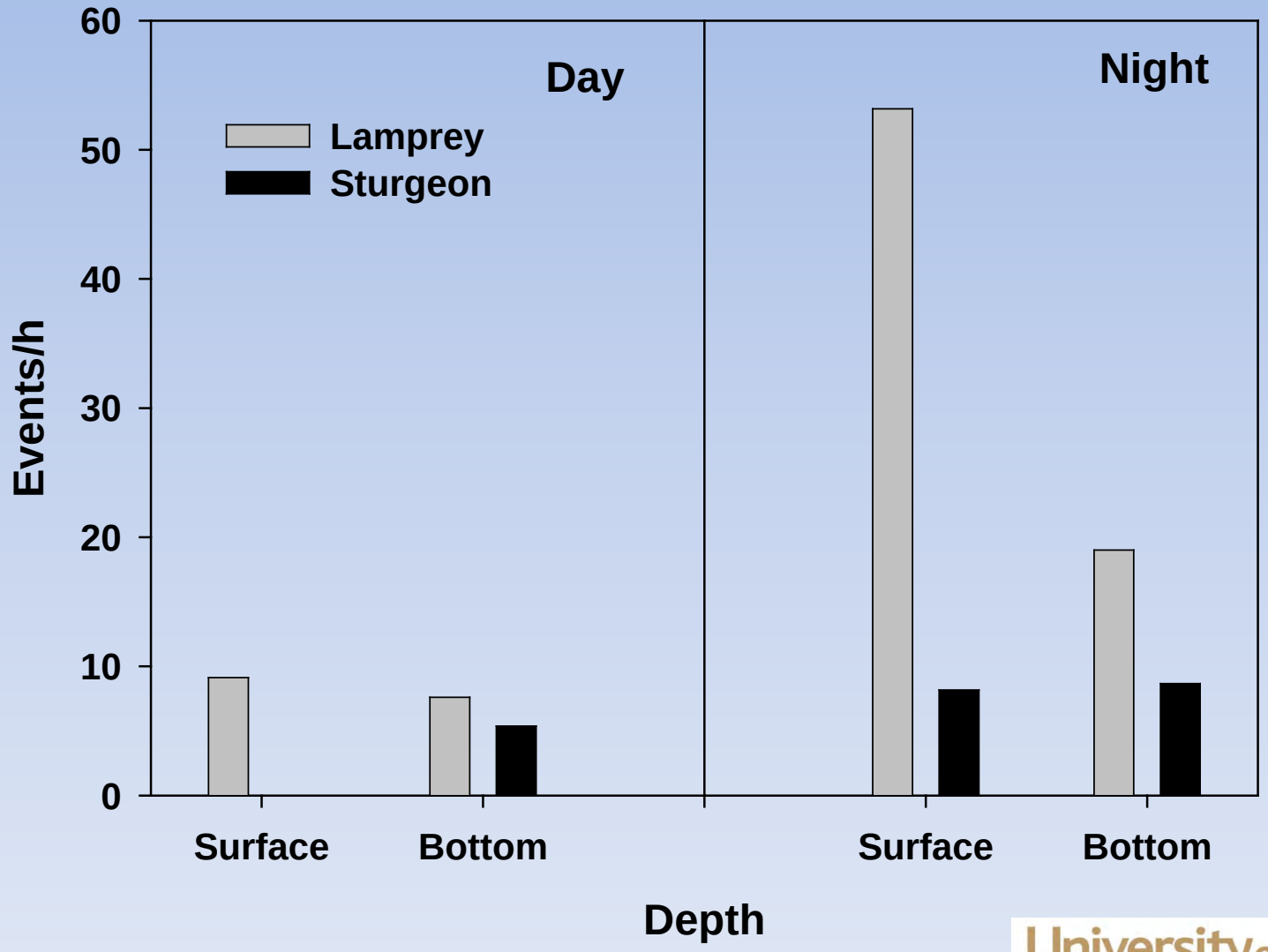


Camera deployed at two depths

North Downstream Entrance - Events Per Hour



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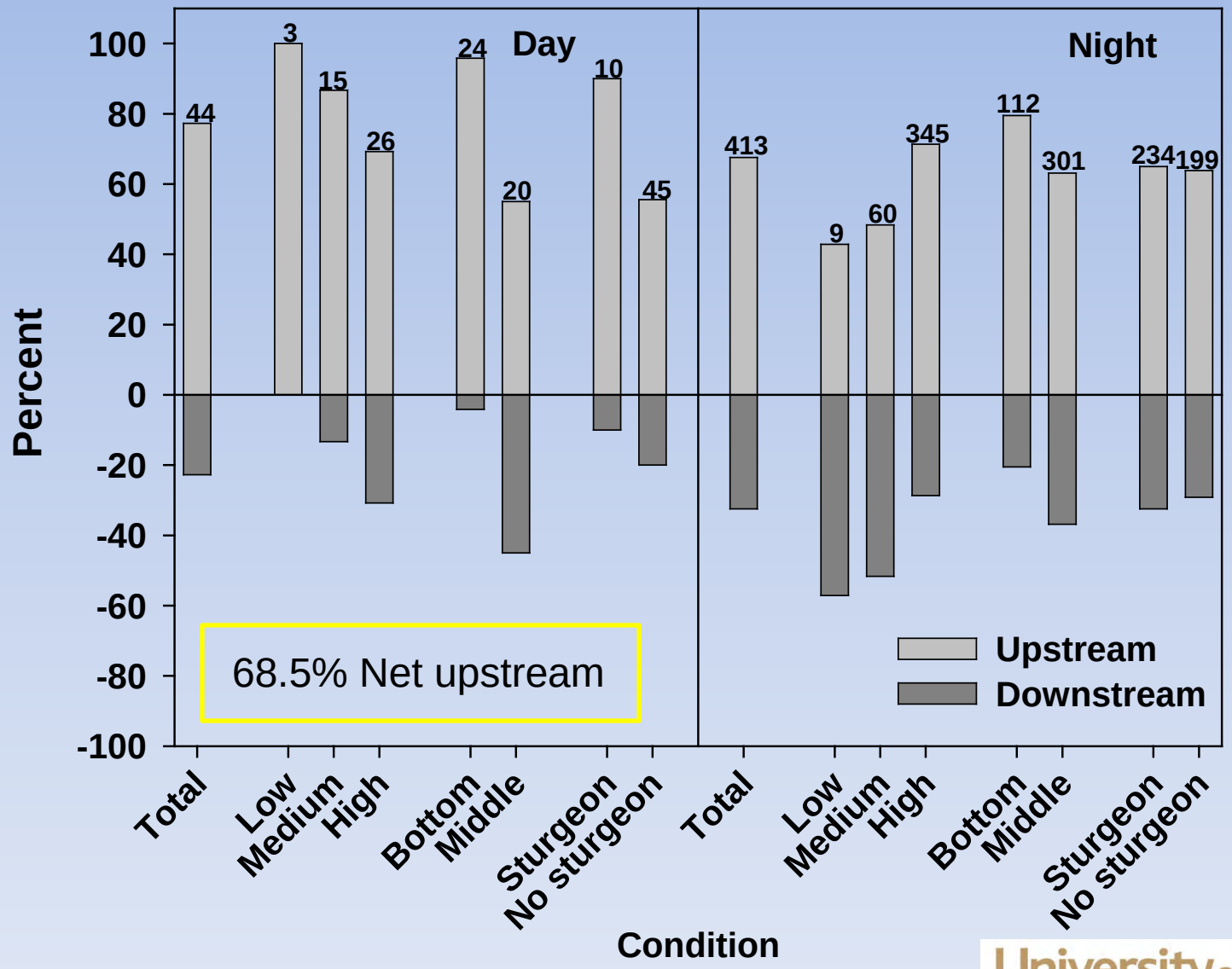
North Downstream Entrance – Net Movement



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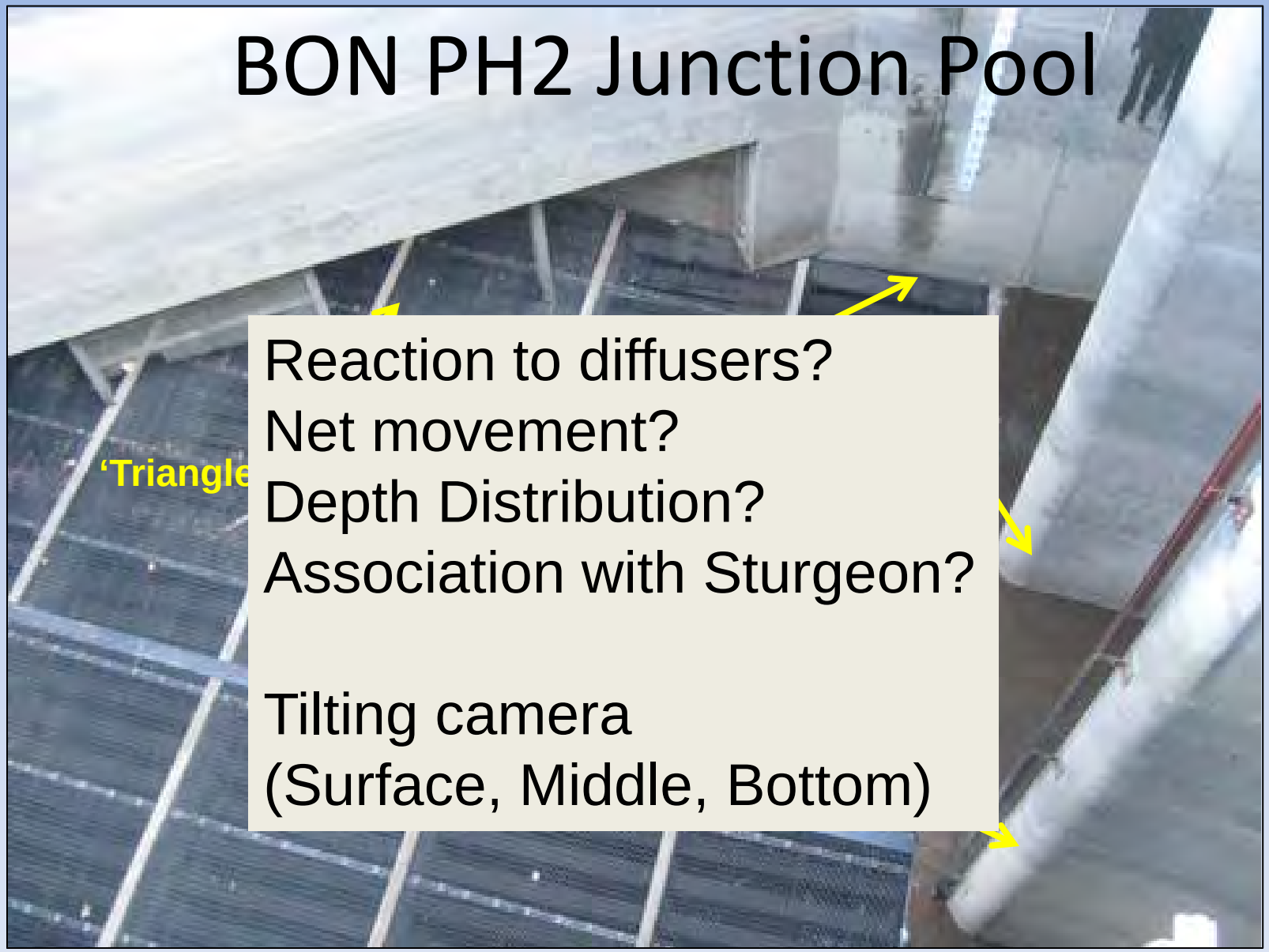
BON PH2 Junction Pool



Reaction to diffusers?
Net movement?
Depth Distribution?
Association with Sturgeon?

Tilting camera
(Surface, Middle, Bottom)

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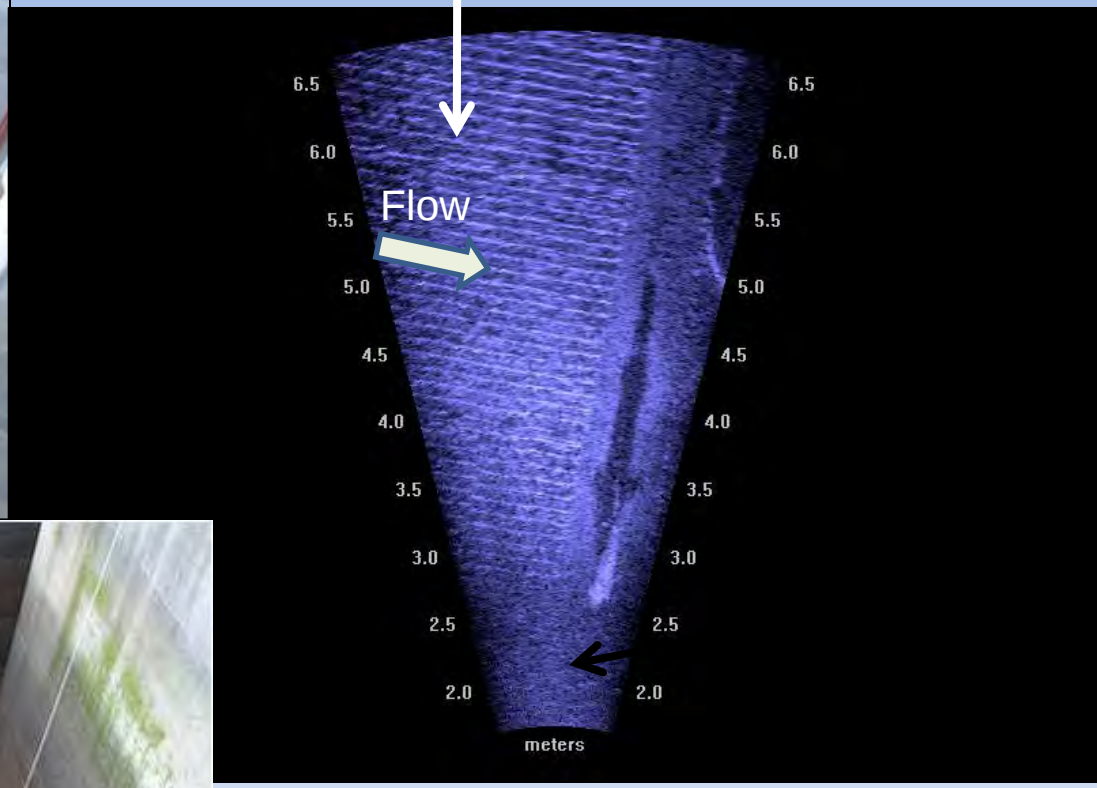
Junction Pool North Deployment



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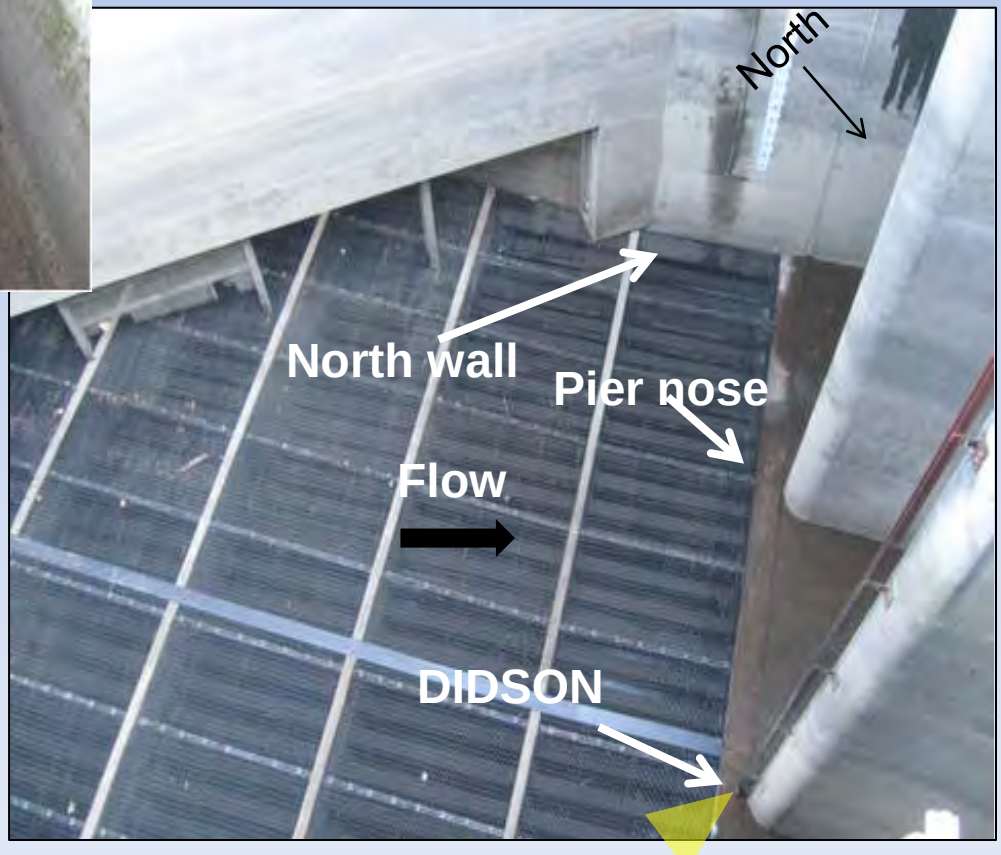
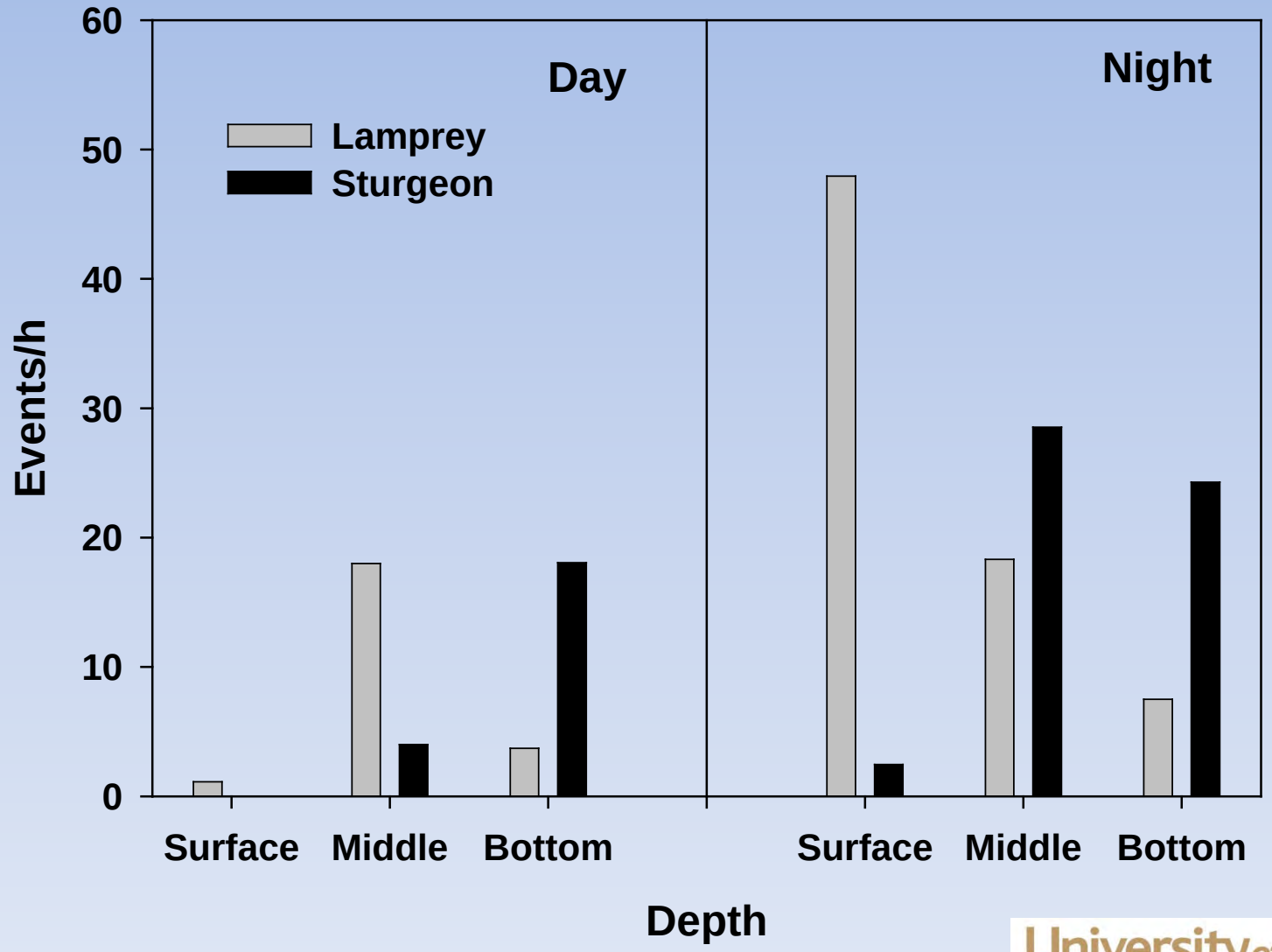
Junction Pool West Deployment



Junction Pool West (NDE) - Events Per Hour



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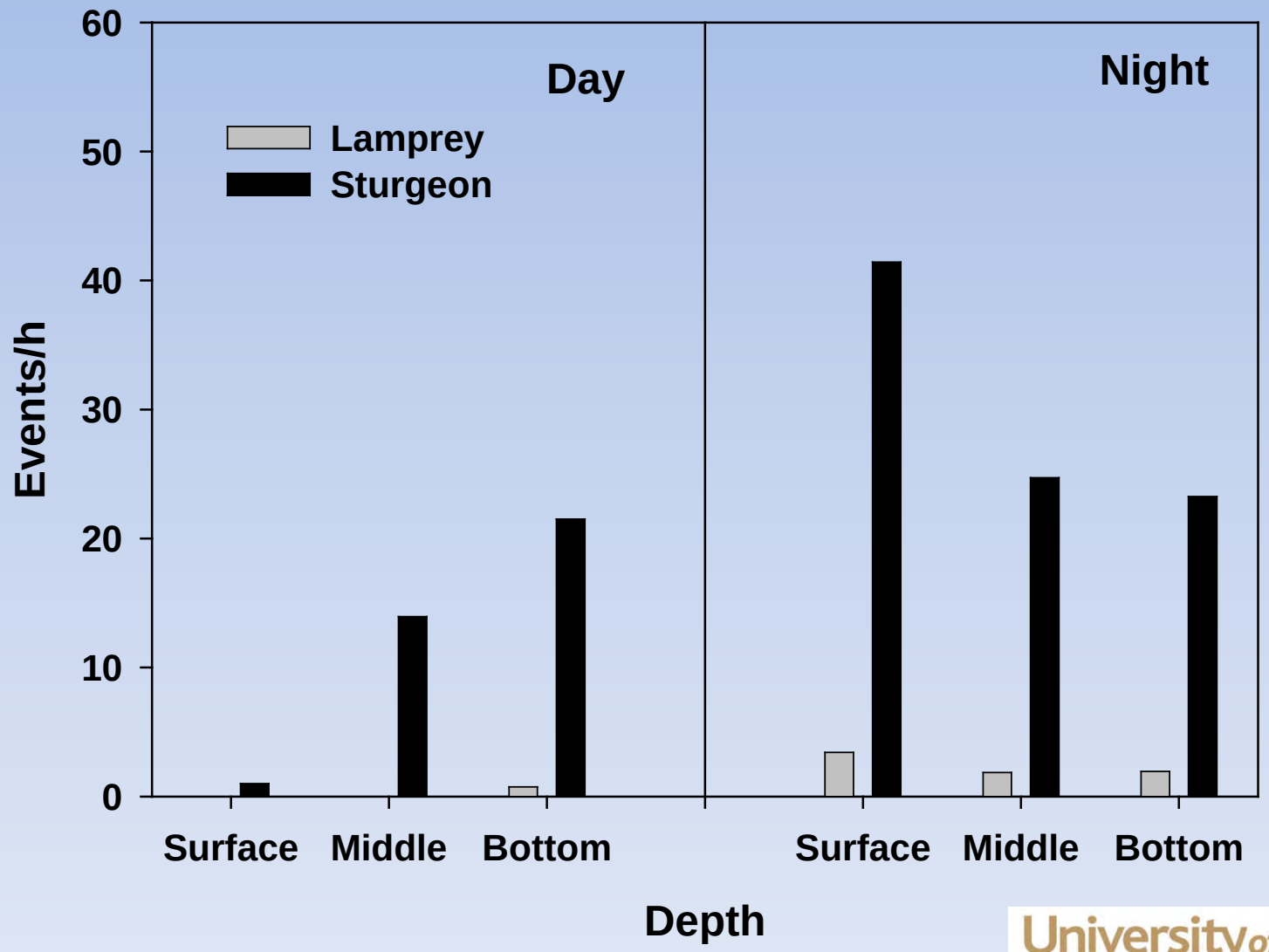
Junction Pool North (NUE) - Events Per Hour



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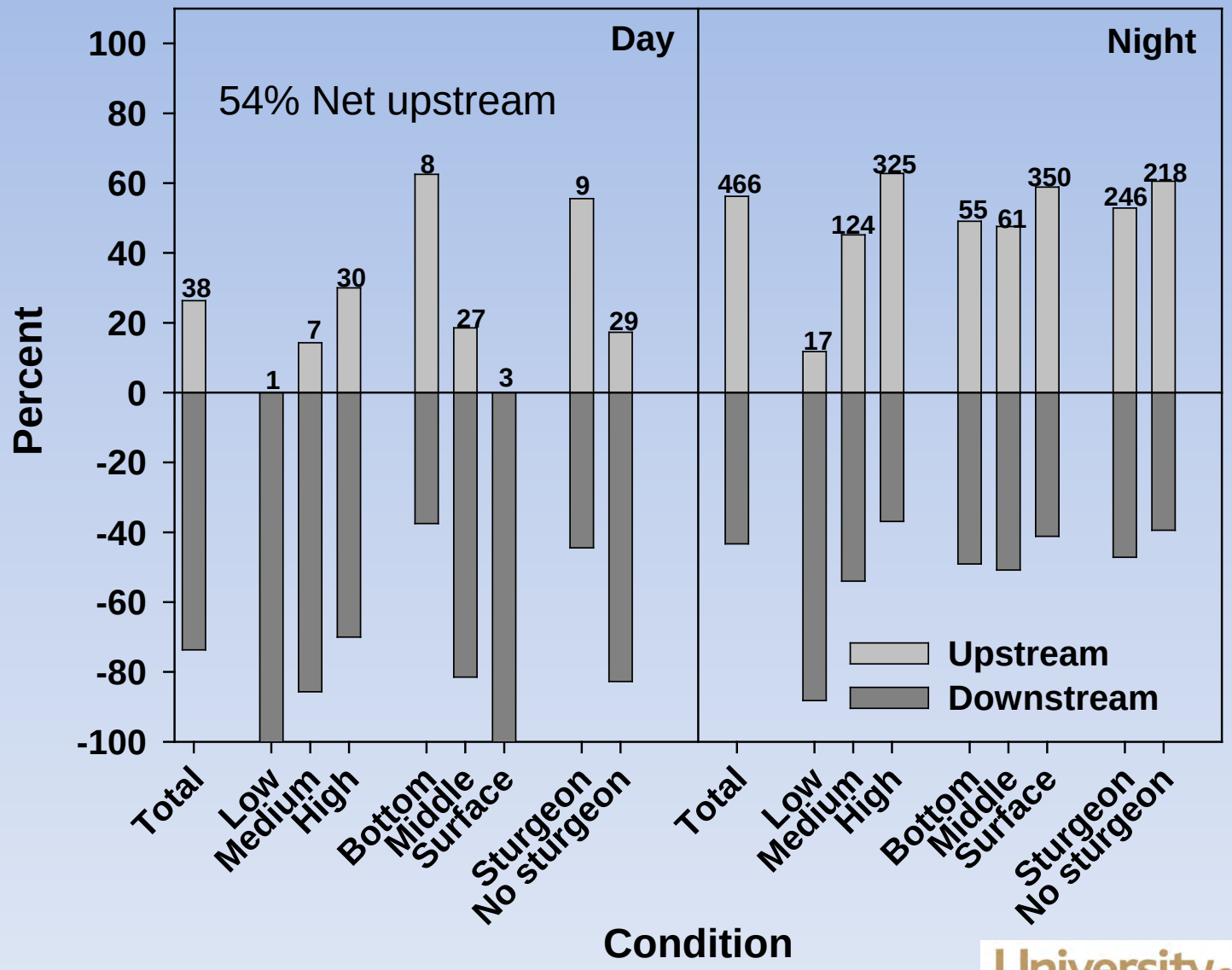
Junction Pool West (NDE) – Net Movement



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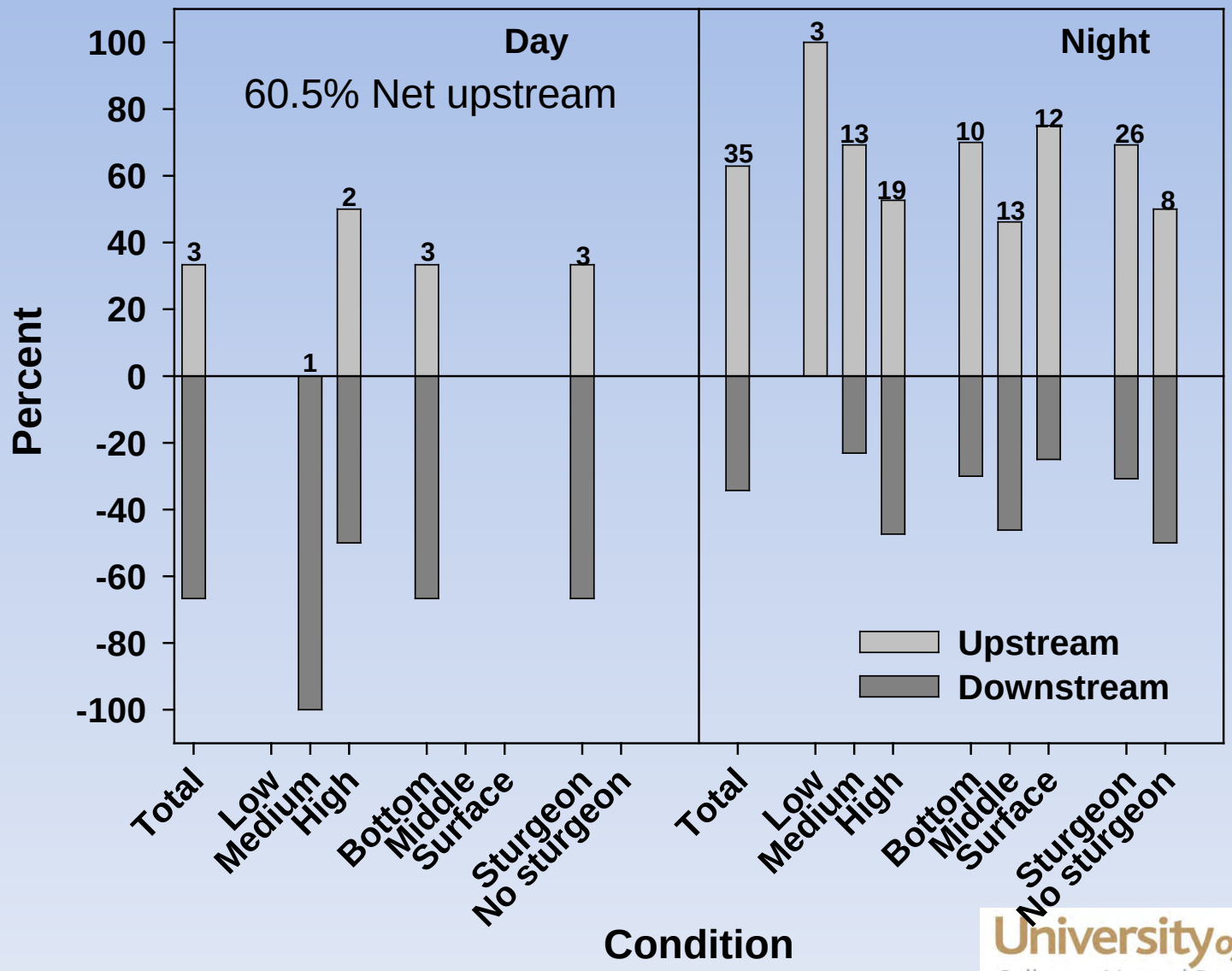
Junction Pool North (NUE) – Net Movement



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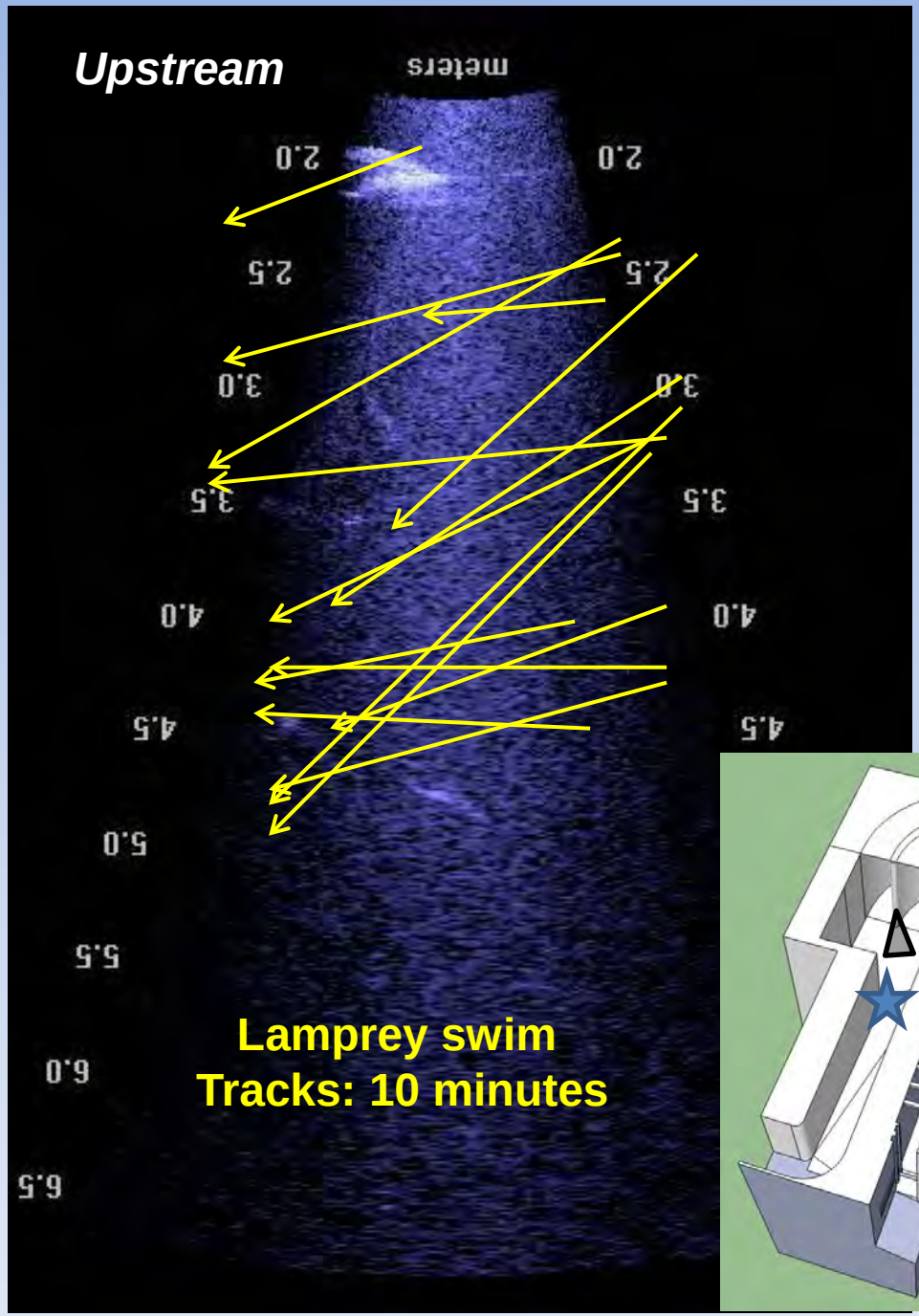
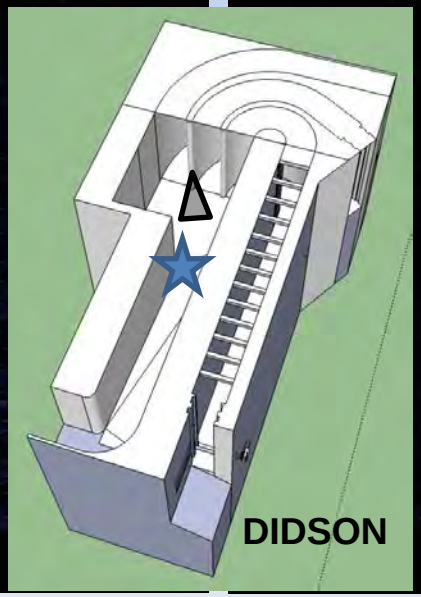
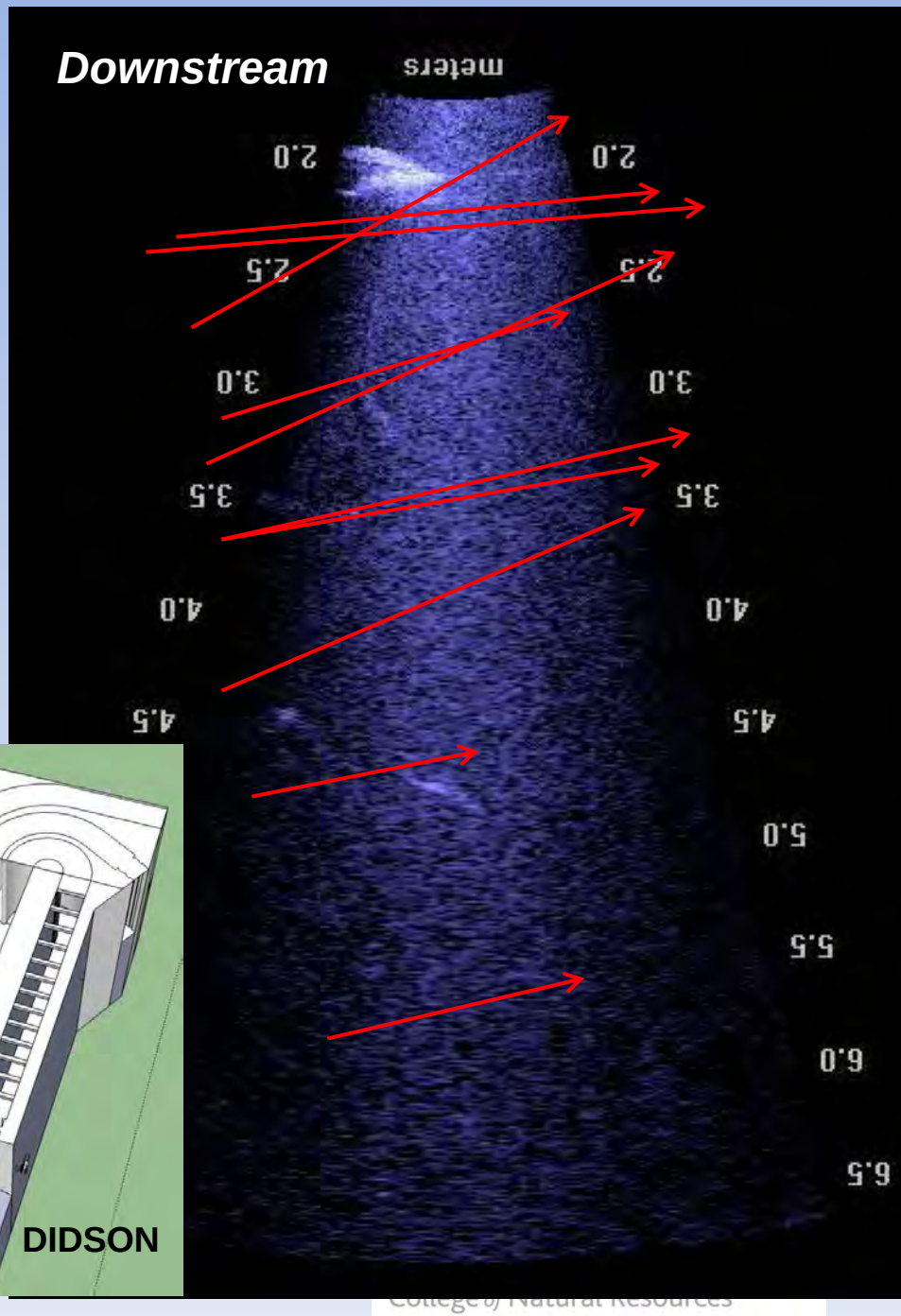

Upstream
meters
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
Lamprey swim
Tracks: 10 minutes


DIDSON


Downstream
meters
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5

2012 Bonneville Preliminary Results

- NDE Entrance area
  - Net upstream movement
  - Use of upper water column common
  - Few sturgeon
- Junction Pool
  - No response/rejection at diffusers
  - Substantial milling, slight net upstream movement
  - Negative association with sturgeon
  - Turnarounds at transition pool?

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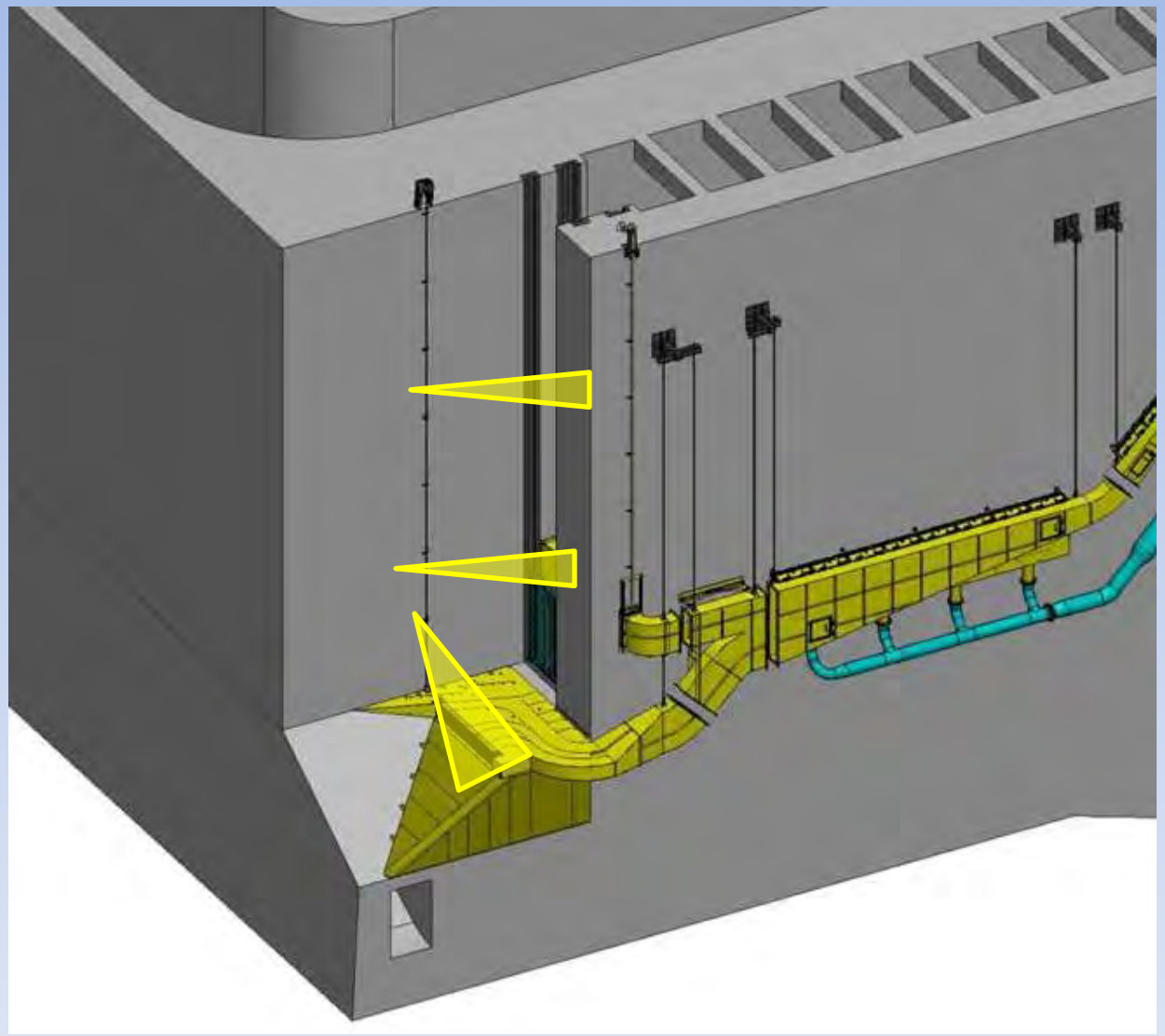
BON Washington Shore LFS 2013



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John Day Dam

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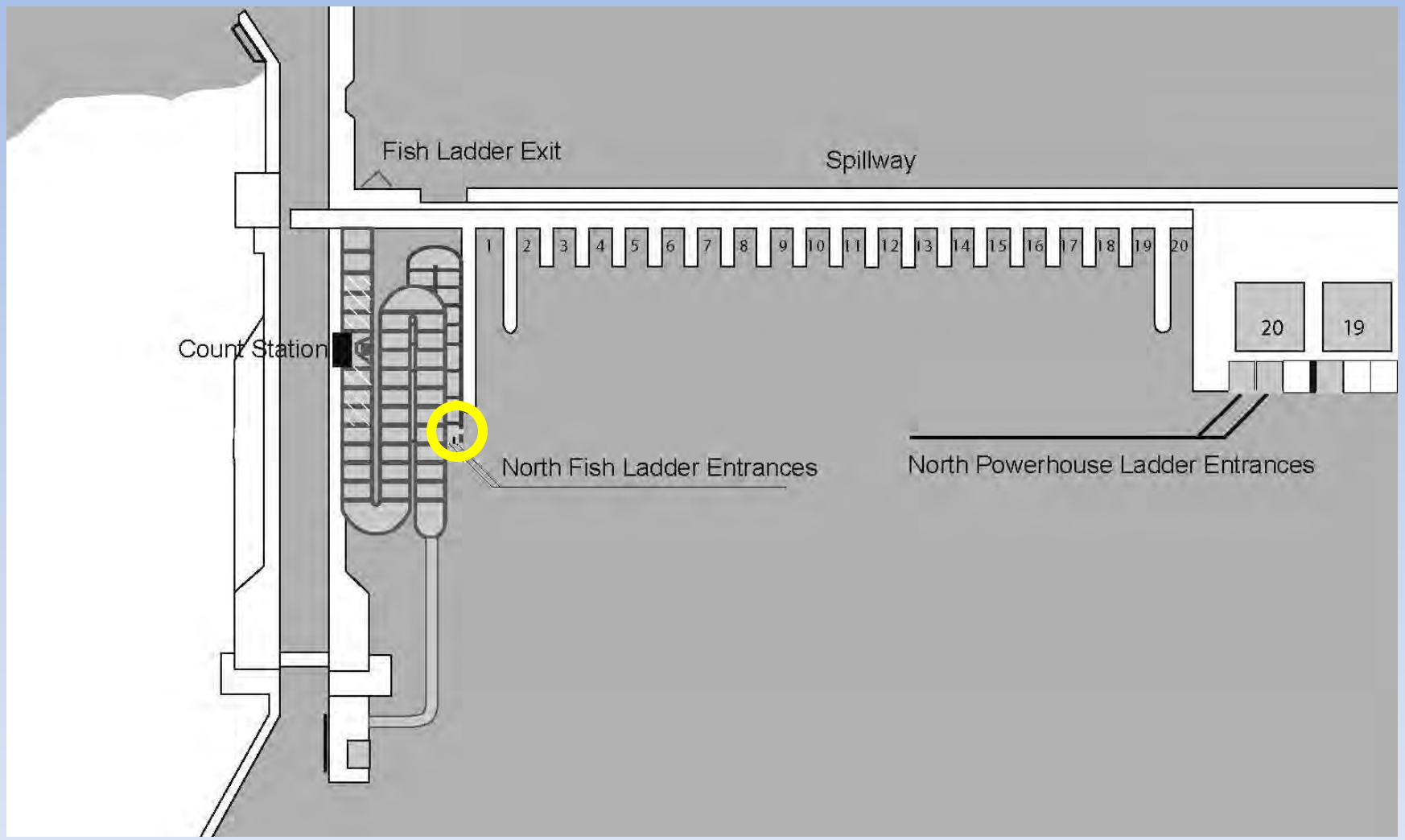
John Day DIDSON Study Site



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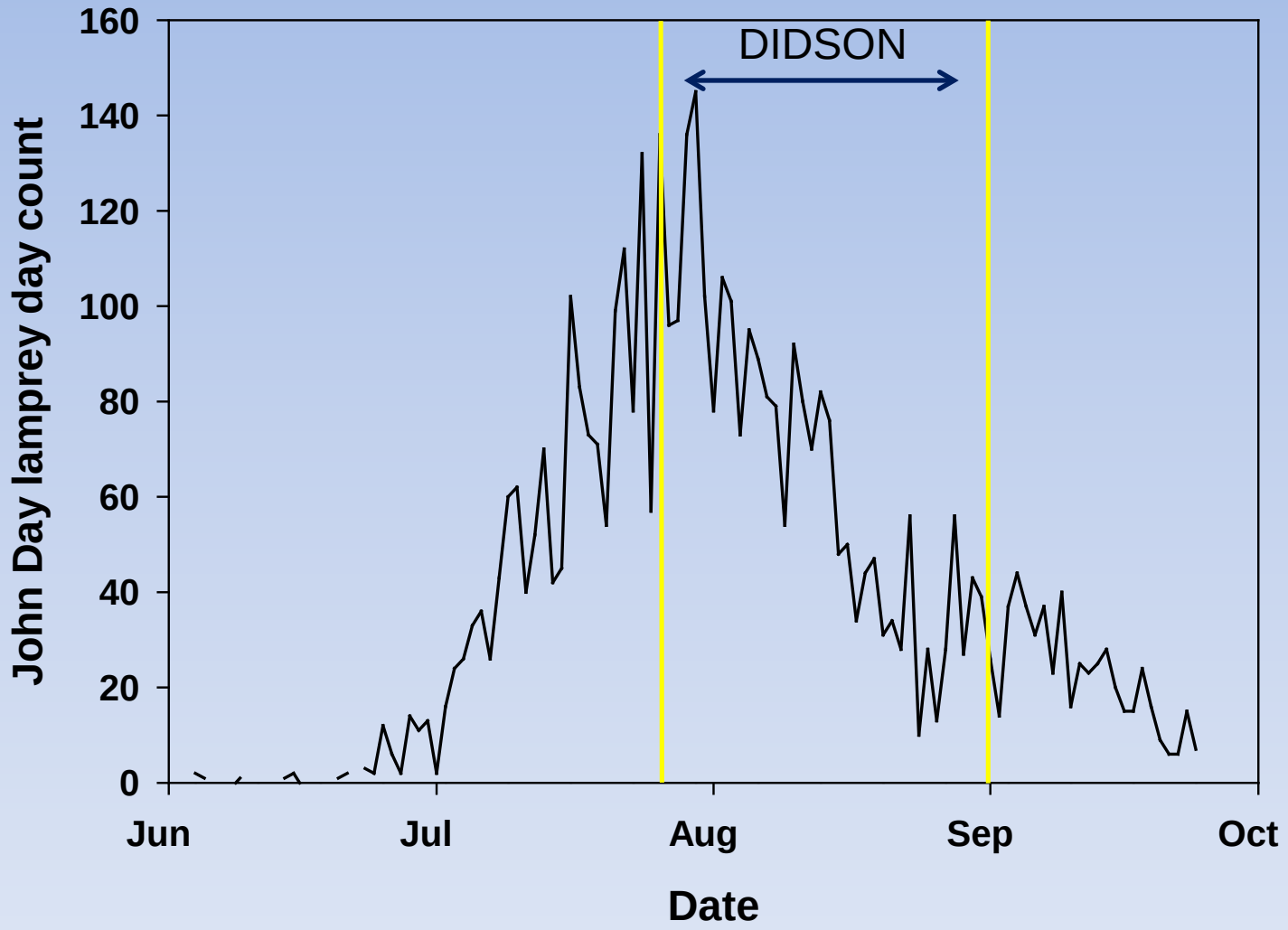
John Day DIDSON Deployment



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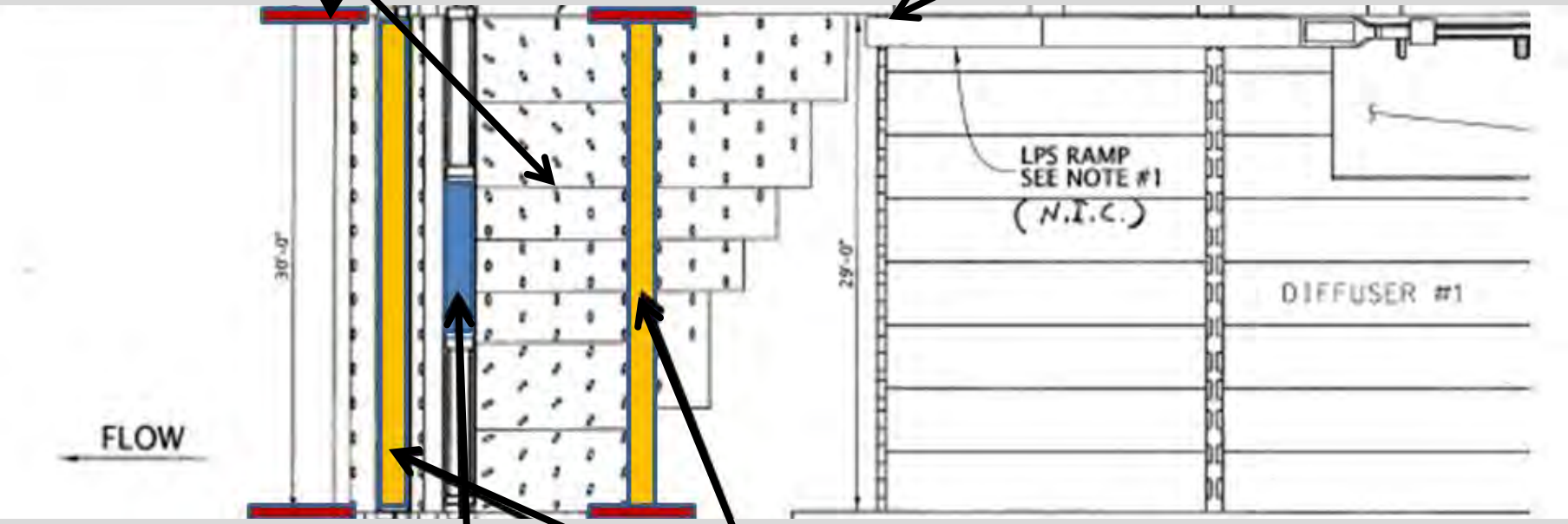
John Day North Fishway

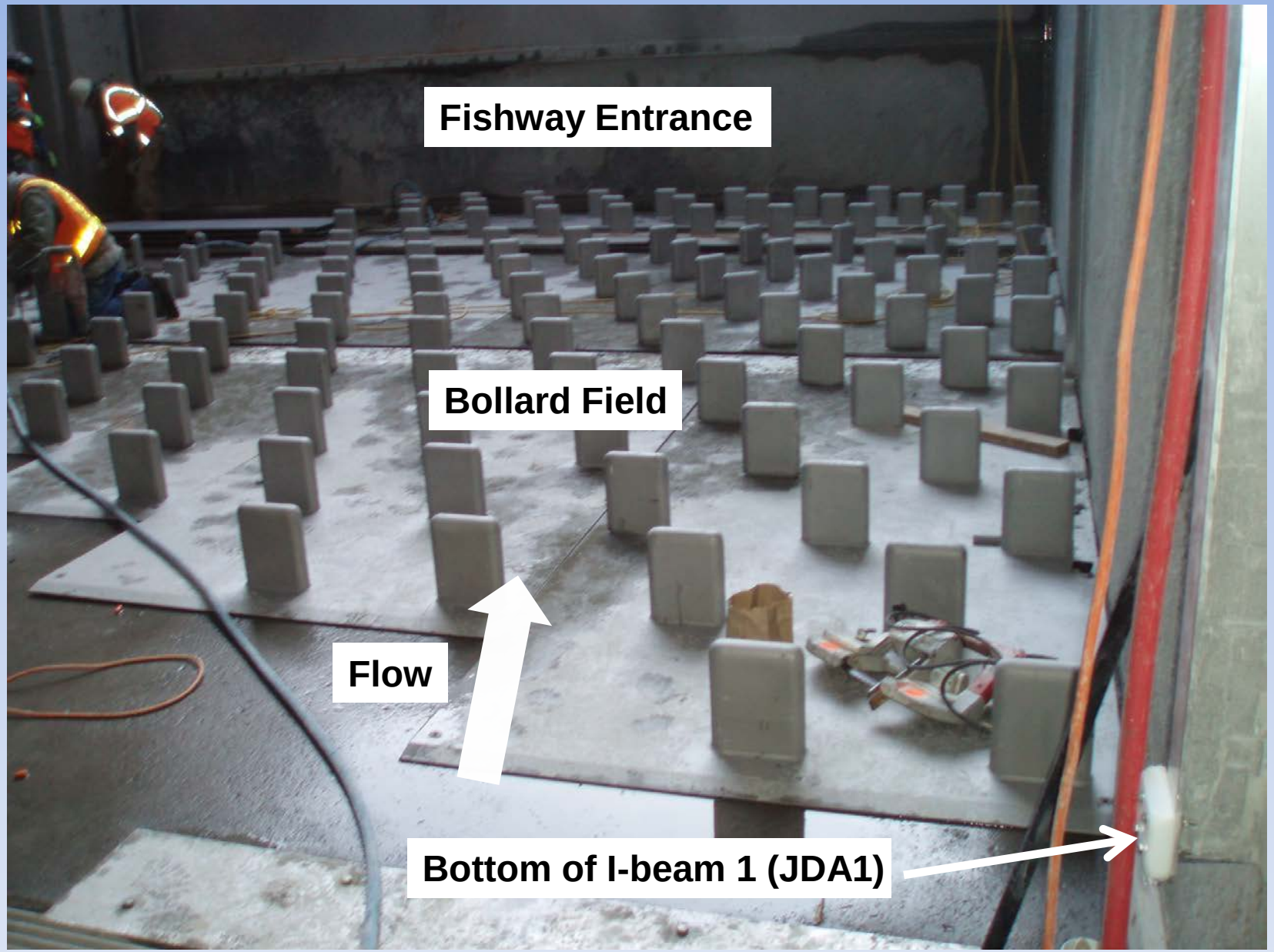
DIDSON I-beams (red) and sample volumes (Yellow)

LPS Entrance



HD-PIT Antennas (Gold)

Variable Width Entrance Slot (Blue)



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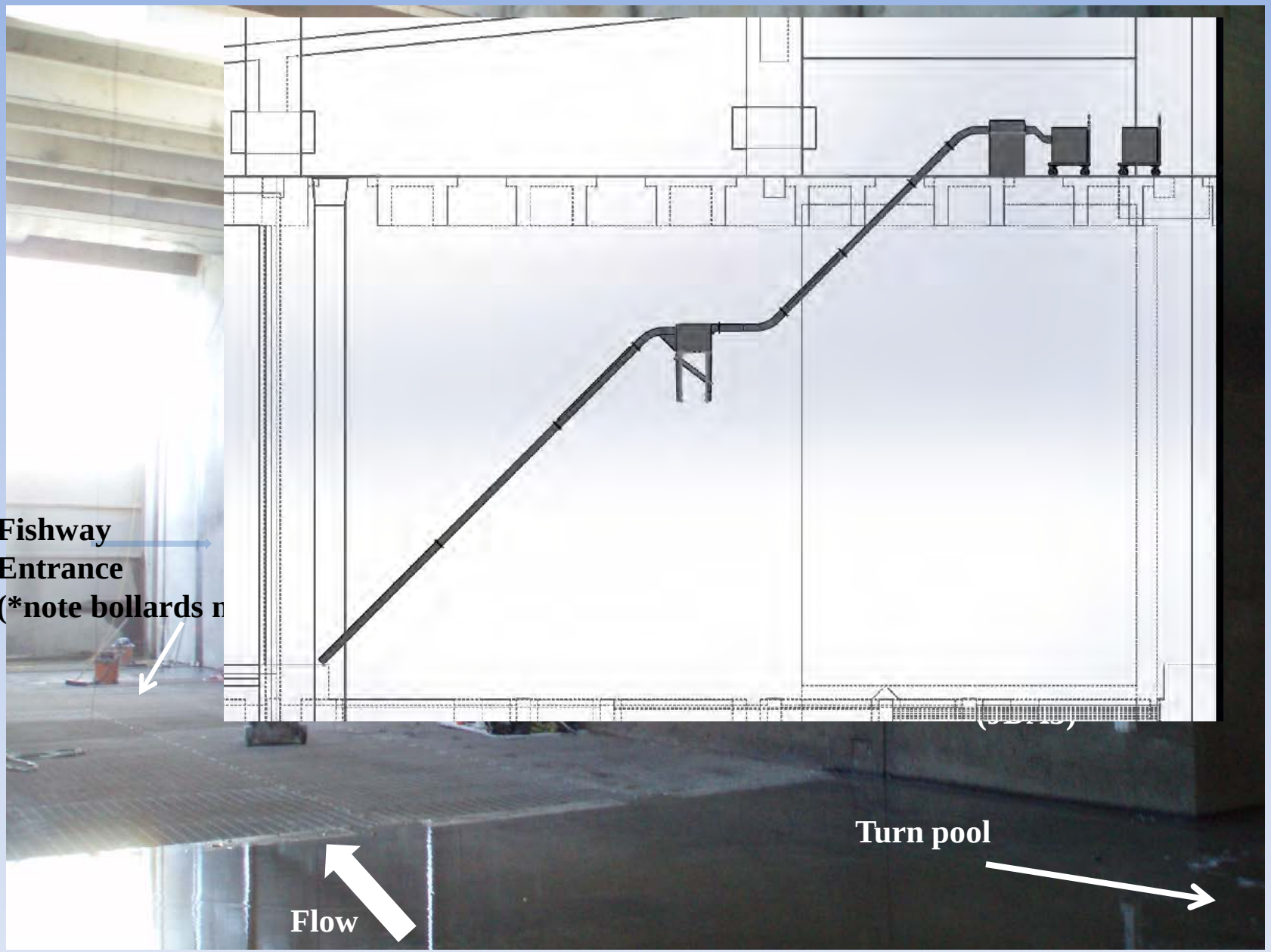

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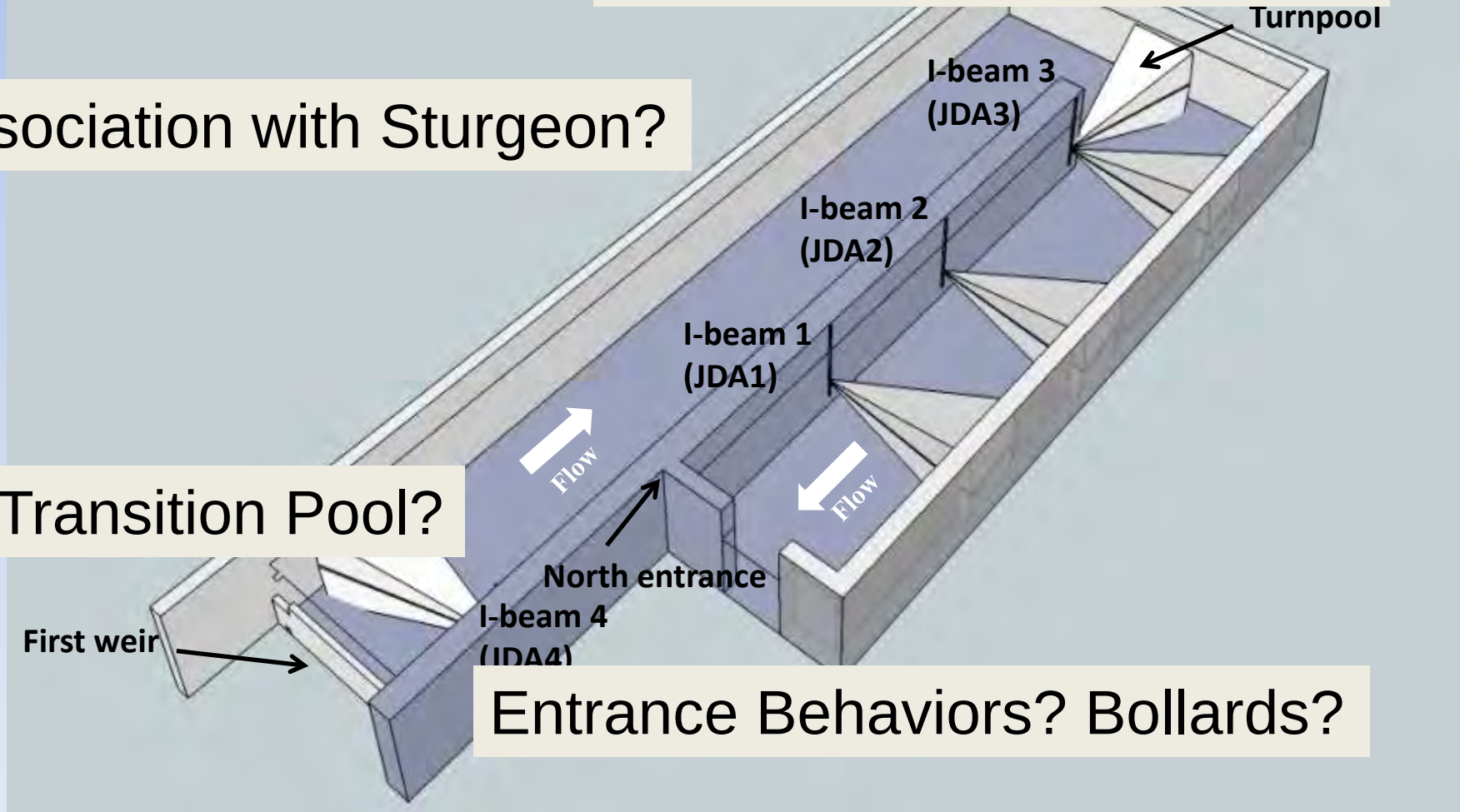
John Day Dam Study Sites

XYZ Distribution?
(Tilting Camera, 4 I-beams)

Association with Sturgeon?



Transition Pool?

Entrance Behaviors? Bollards?

Analyses to Date

		Data collected (h)				Data watched (h)				Data watched (%)		
Site	Orientation	Day	Night	Total		Day	Night	Total		Day	Night	Total
JD1	Portrait	42	26	68		1	4	5		2.4	15.4	7.4
JD1	Landscape	146	91	237		8	16	24		5.5	17.6	10.1
JD2	Landscape	52	34	86		4	7	11		7.7	20.6	12.8
JD3	Landscape	102	59	161		5	11	16		4.9	18.6	9.9
JD4	Landscape	136	85	221		6	11	17		4.4	12.9	7.7

Deployments by site:
JD1=4-Bollard long view, Bollard short view, Cross section (landscape and portrait) and LPS
JD2=2-Cross section and LPS
JD3=3-Cross section, Turnpool cross-section, and LPS
JD4=4-Cross section, Transition pool upstream and downstream, and LPS

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Analyses to Date

John Day Dam	JD1 portrait	JD1 landscape	JD2 landscape	JD3 landscape	JD4 landscape
Files watched	31	140	66	96	98
Hours	5	24	11	16	17
Events (Total)	20	136	40	49	19
Events/h	4.0	5.7	3.6	1.2	1.1
Confidence Class					
Low	11 (55%)	35 (26%)	15 (38%)	14 (29%)	9 (47%)
Medium	4 (20%)	55 (40%)	10 (25%)	23 (47%)	6 (32%)
High	5 (25%)	46 (34%)	15 (38%)	12 (24%)	4 (21%)

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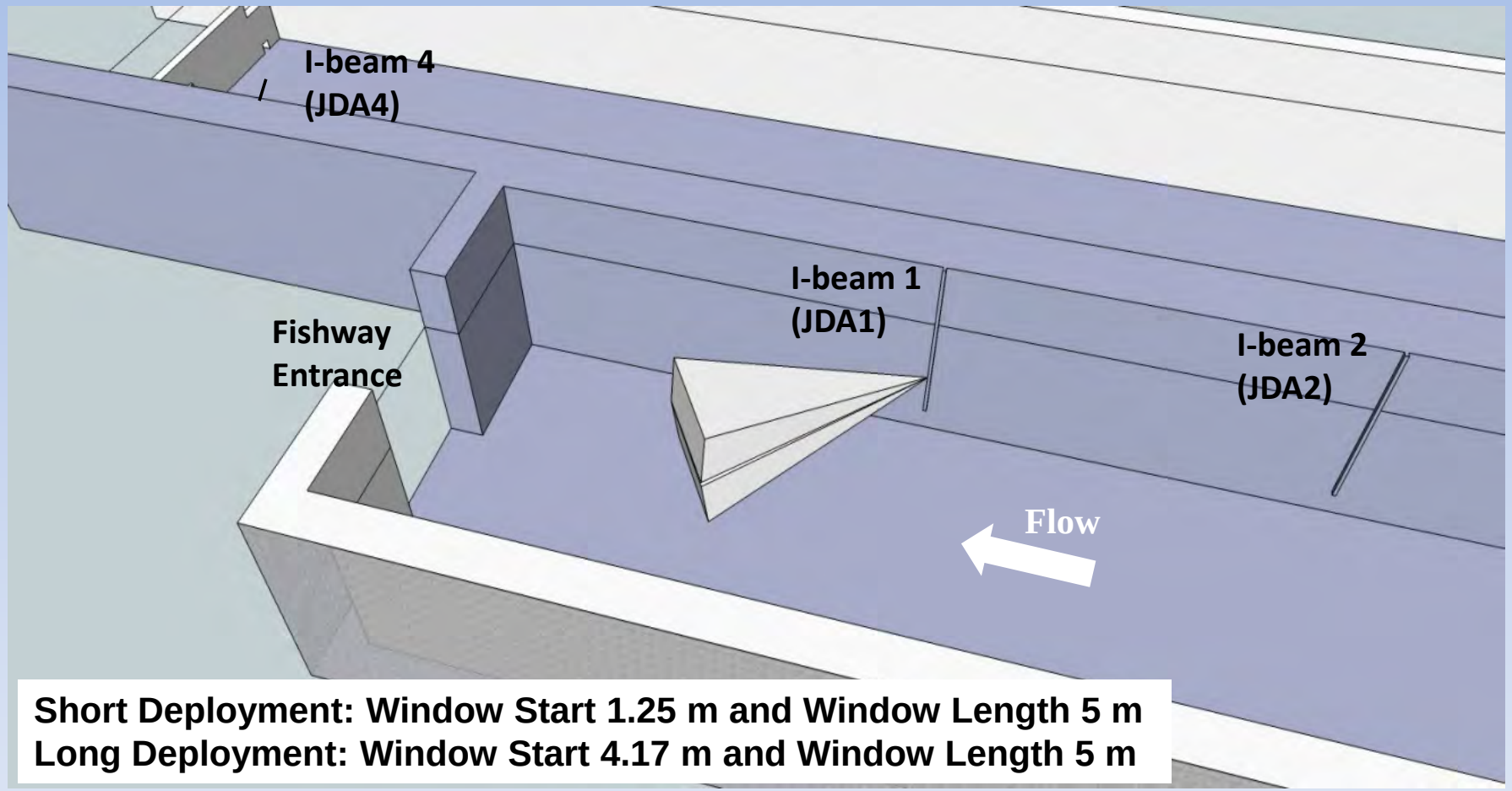
John Day Entrance Short and Long Deployment



Short Deployment: Window Start 1.25 m and Window Length 5 m
Long Deployment: Window Start 4.17 m and Window Length 5 m

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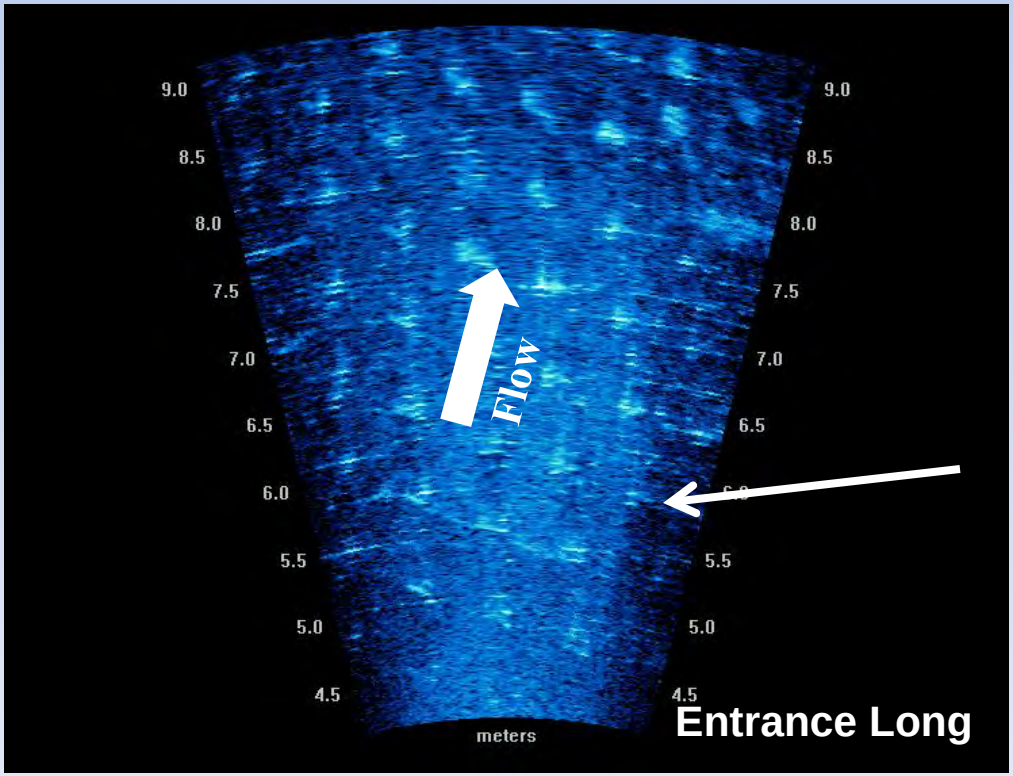
John Day Entrance Short and Long Deployment

- Lamprey observed in bollard field



Acoustic reflection from bollards

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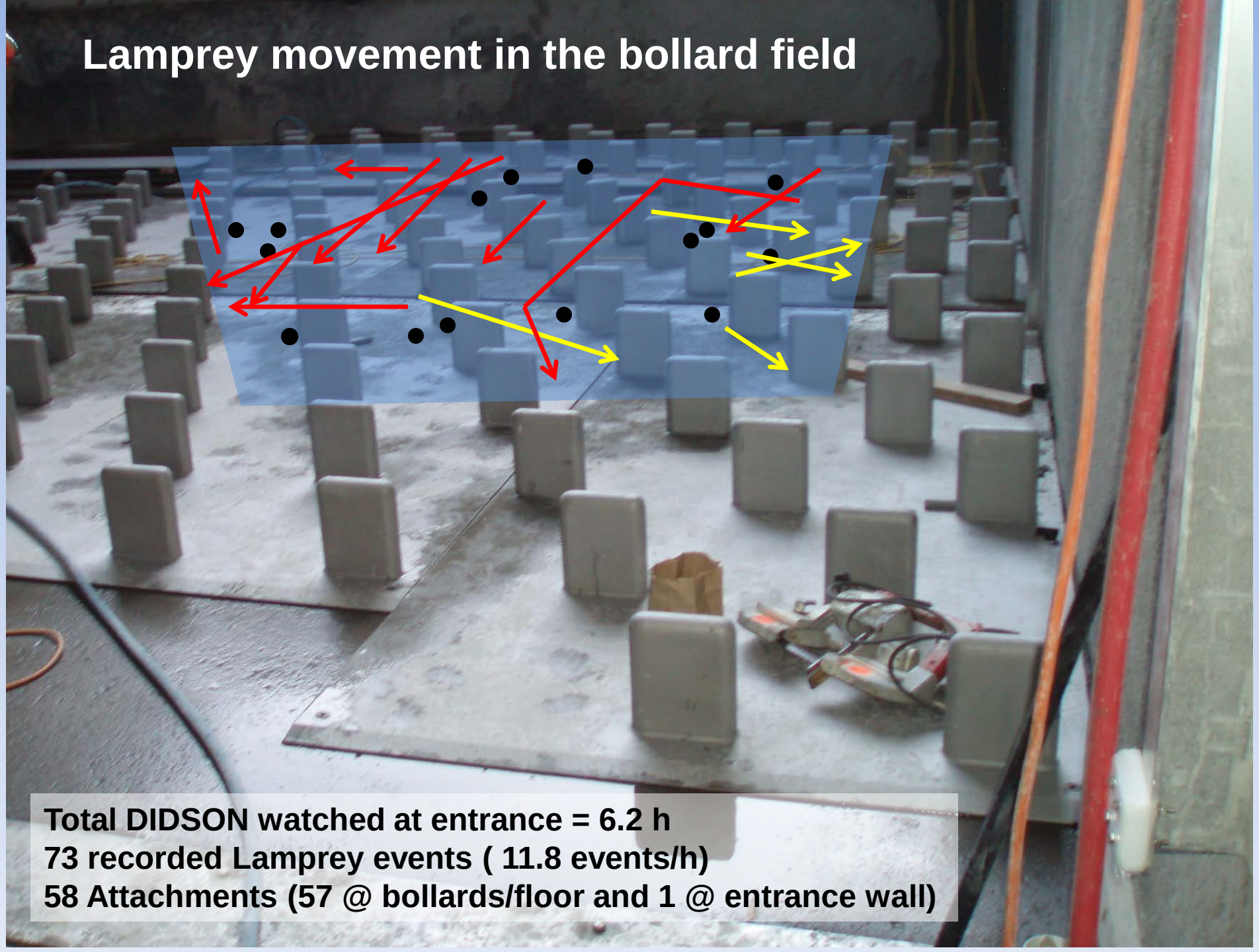
Lamprey movement in the bollard field

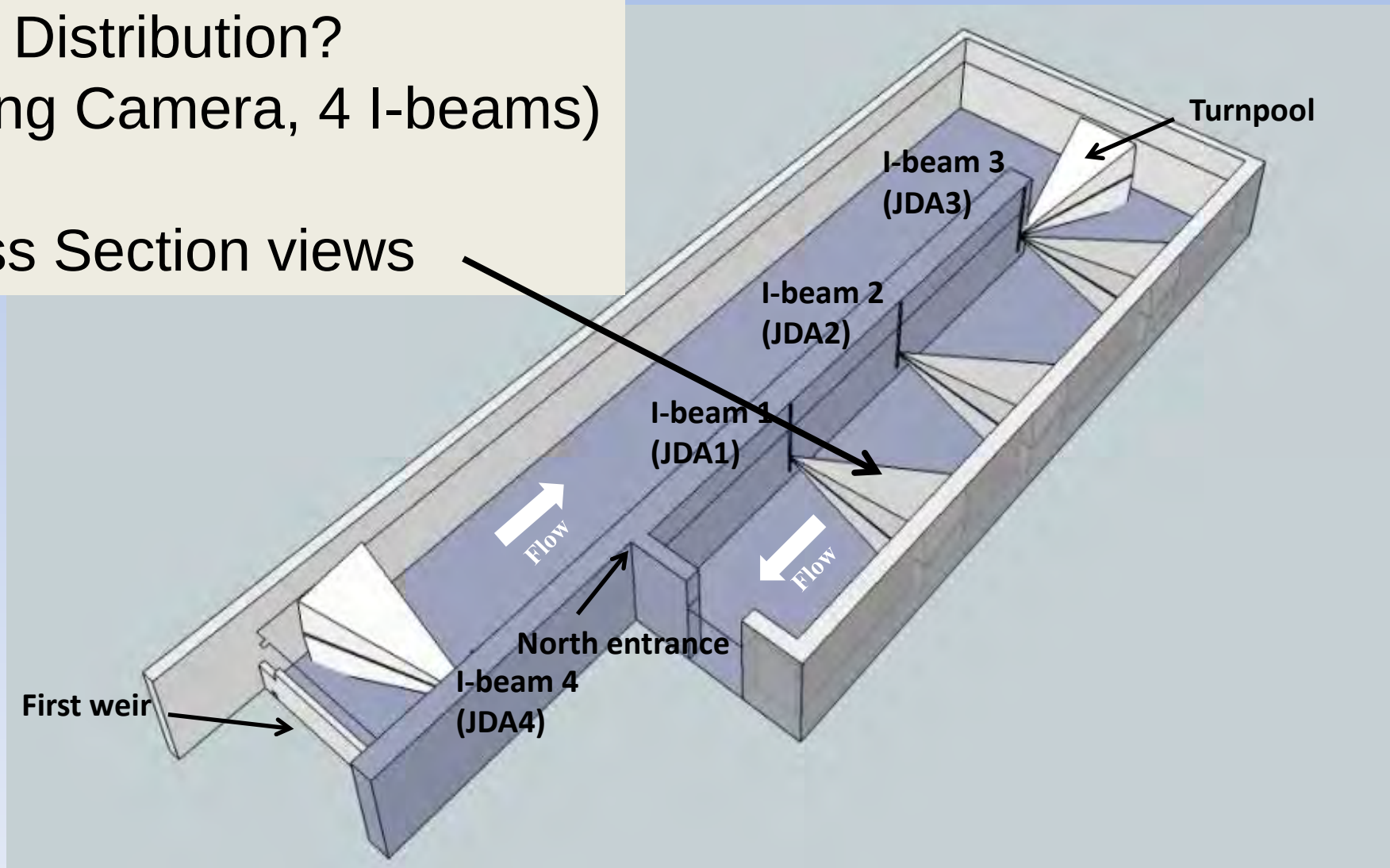


Total DIDSON watched at entrance = 6.2 h
73 recorded Lamprey events (11.8 events/h)
58 Attachments (57 @ bollards/floor and 1 @ entrance wall)

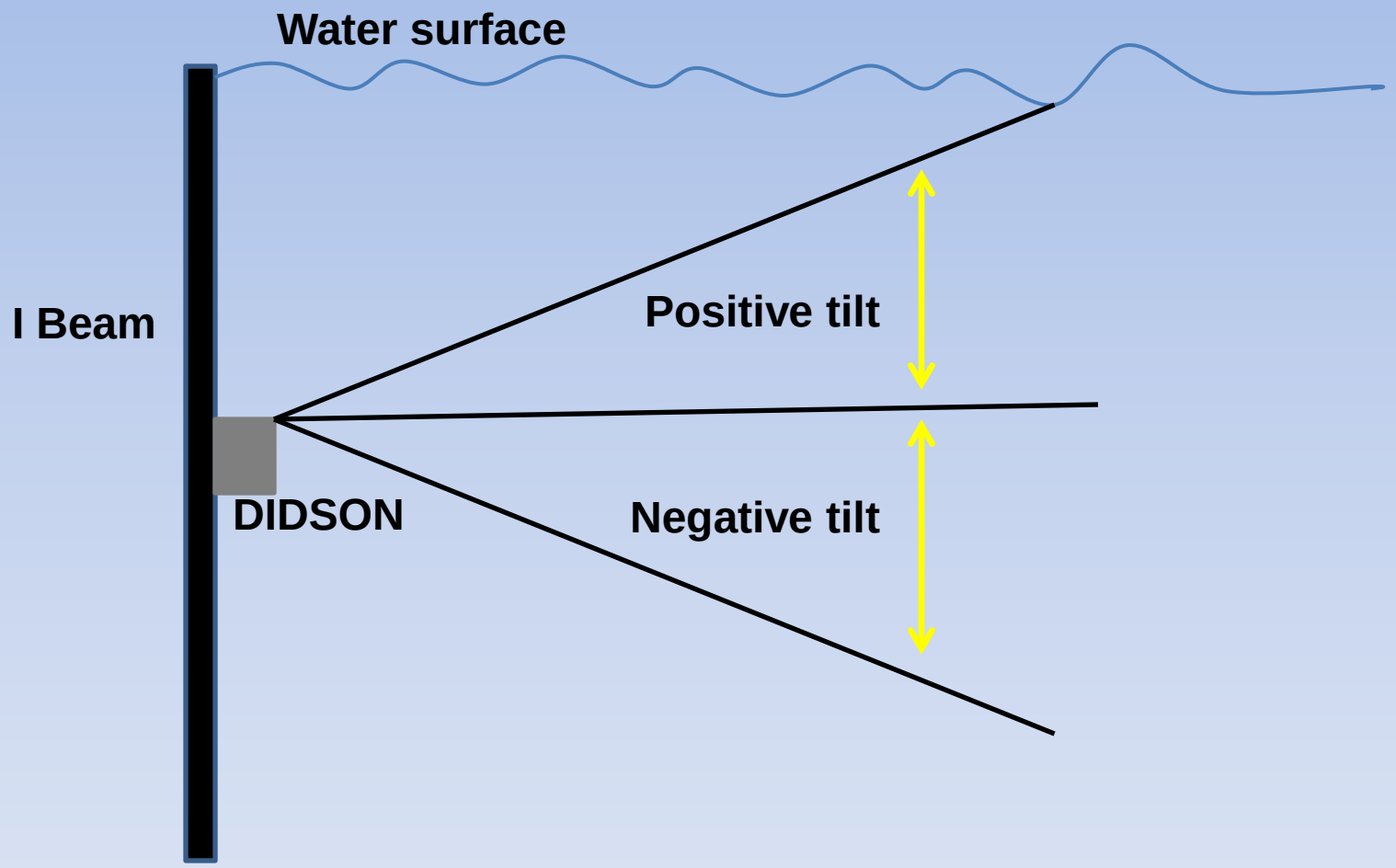
John Day Dam Study Sites

XYZ Distribution?
(Tilting Camera, 4 I-beams)

Cross Section views



DIDSON Camera Tilt



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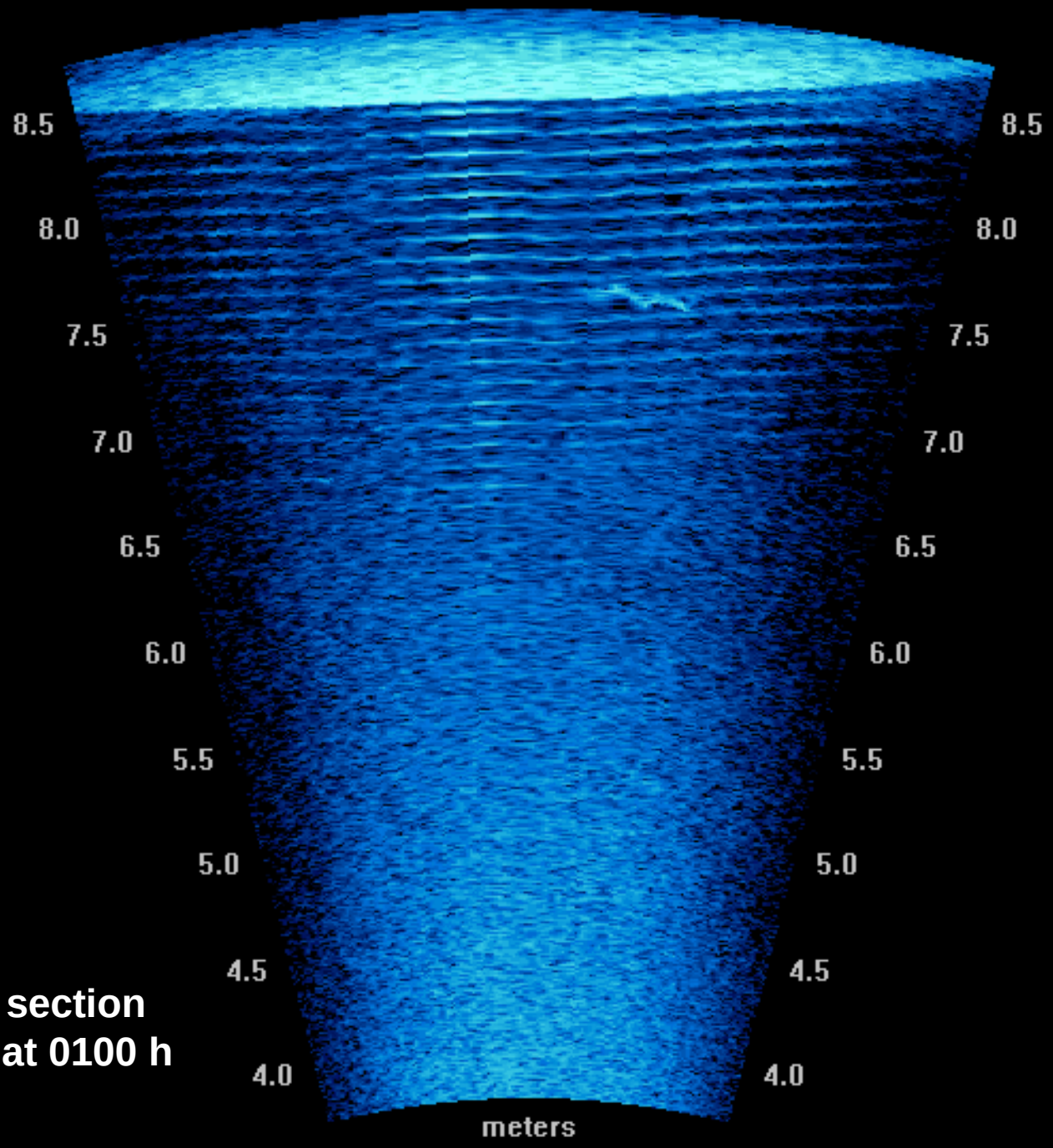
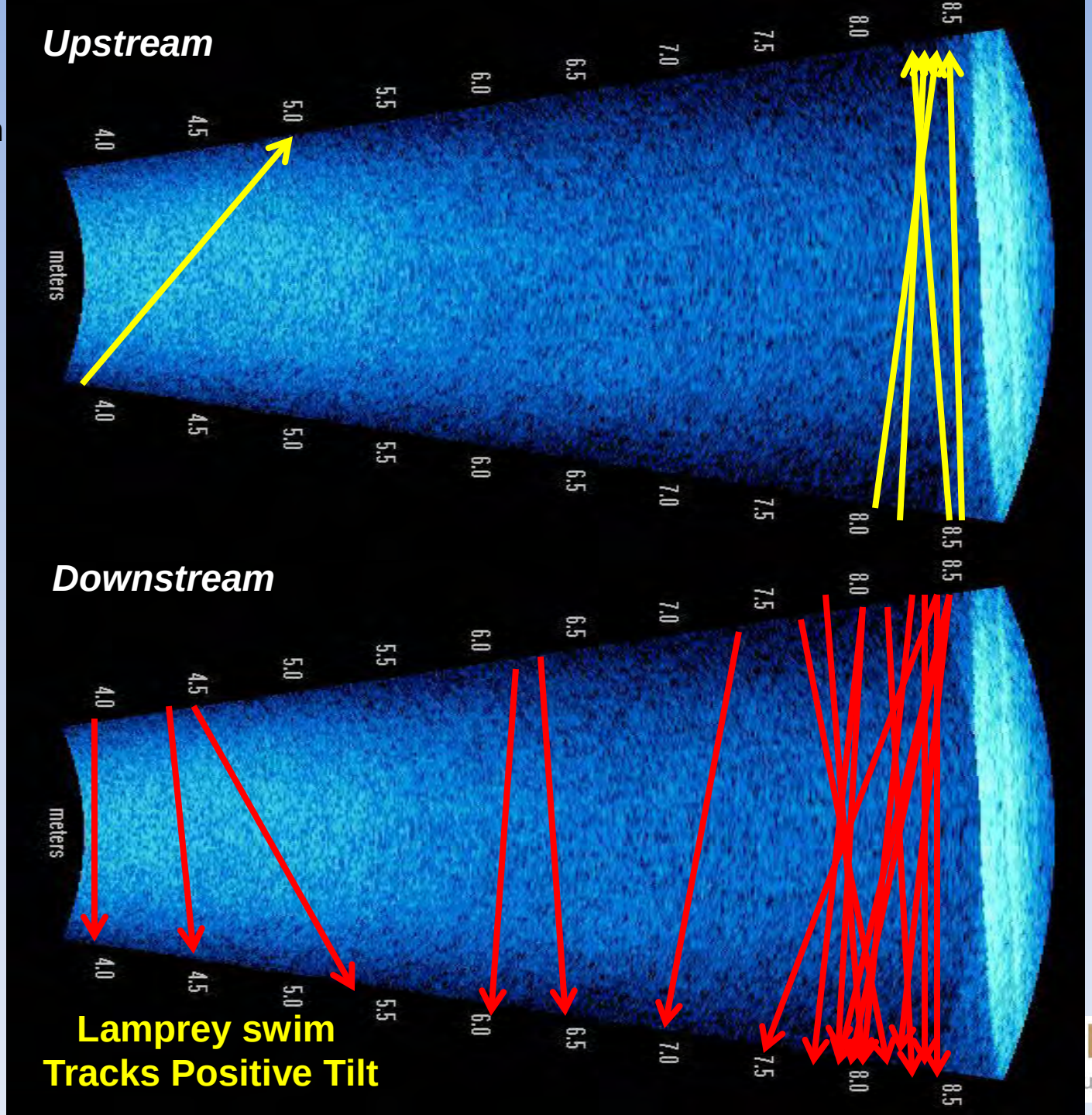
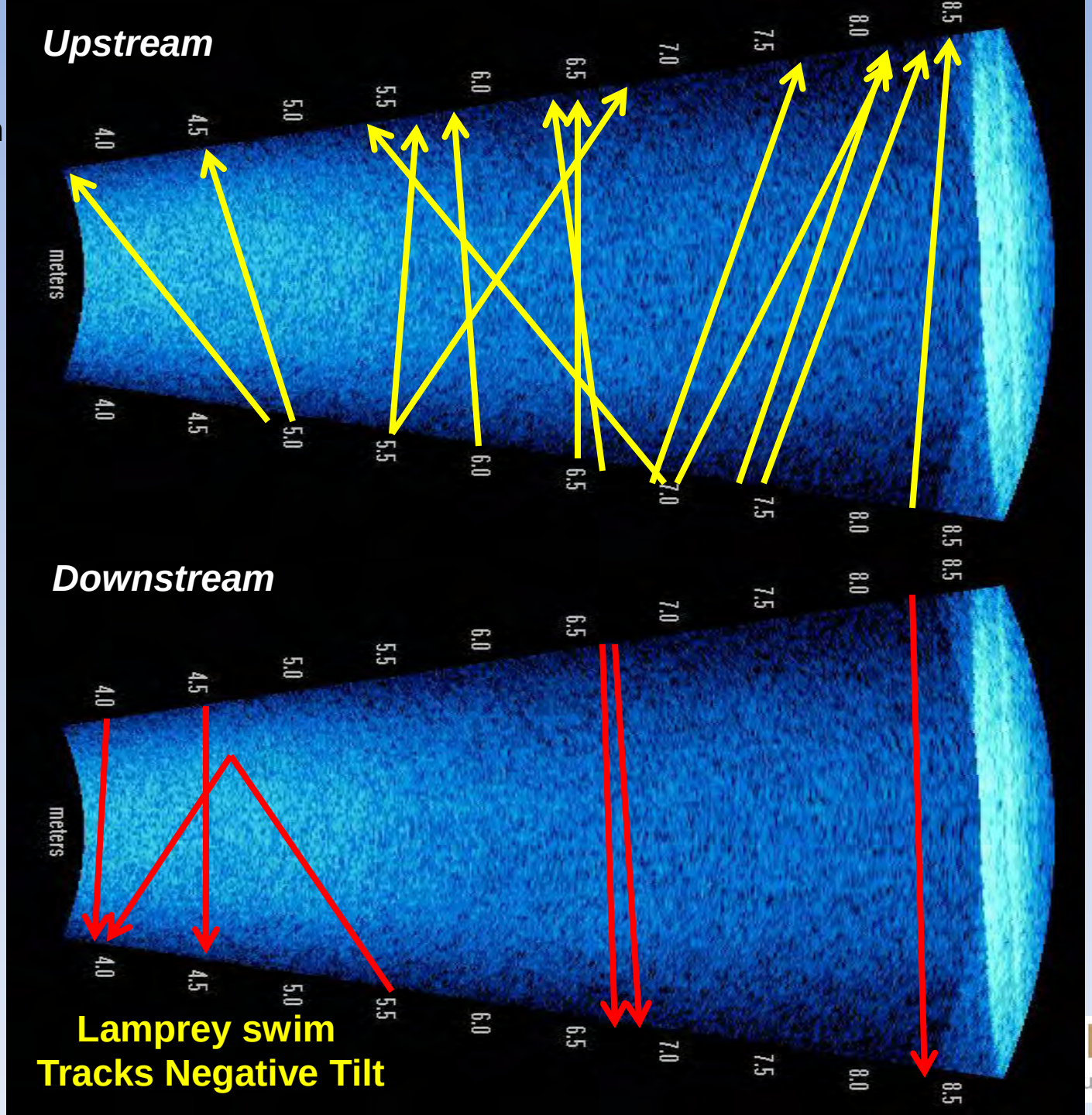


JD2 Cross section
August 27 at 0100 h

JD1
Cross section
Upper Water
Column

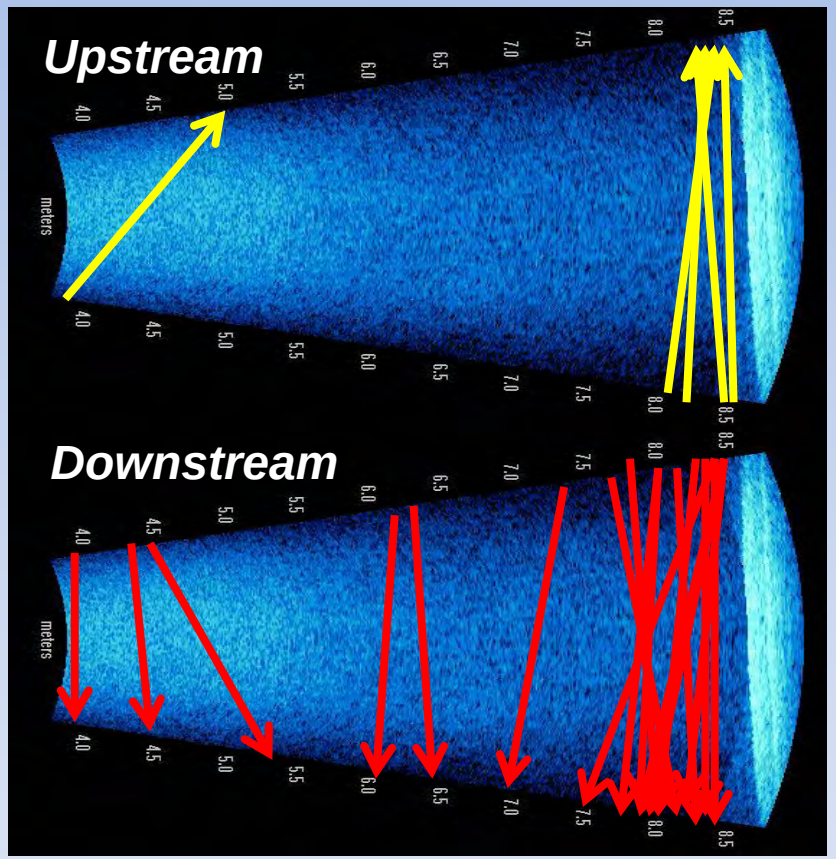


JD1
Cross section
Lower Water
Column



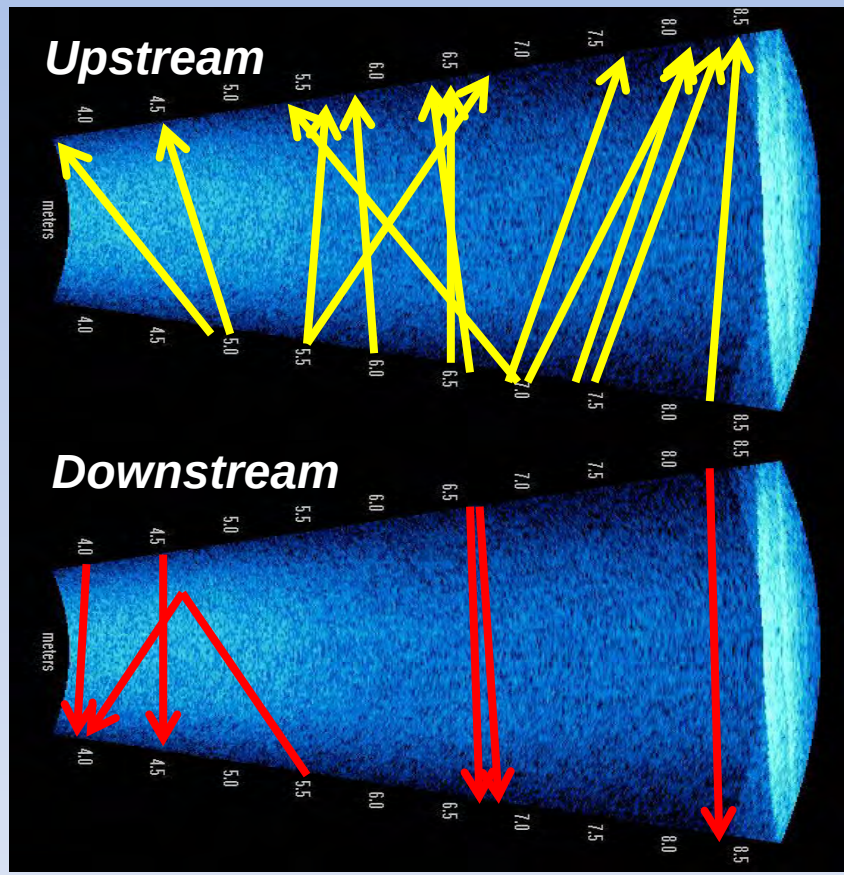
JD1
Cross section

Lamprey swim
Tracks Positive Tilt



Upper

Lamprey swim
Tracks Negative Tilt



Lower

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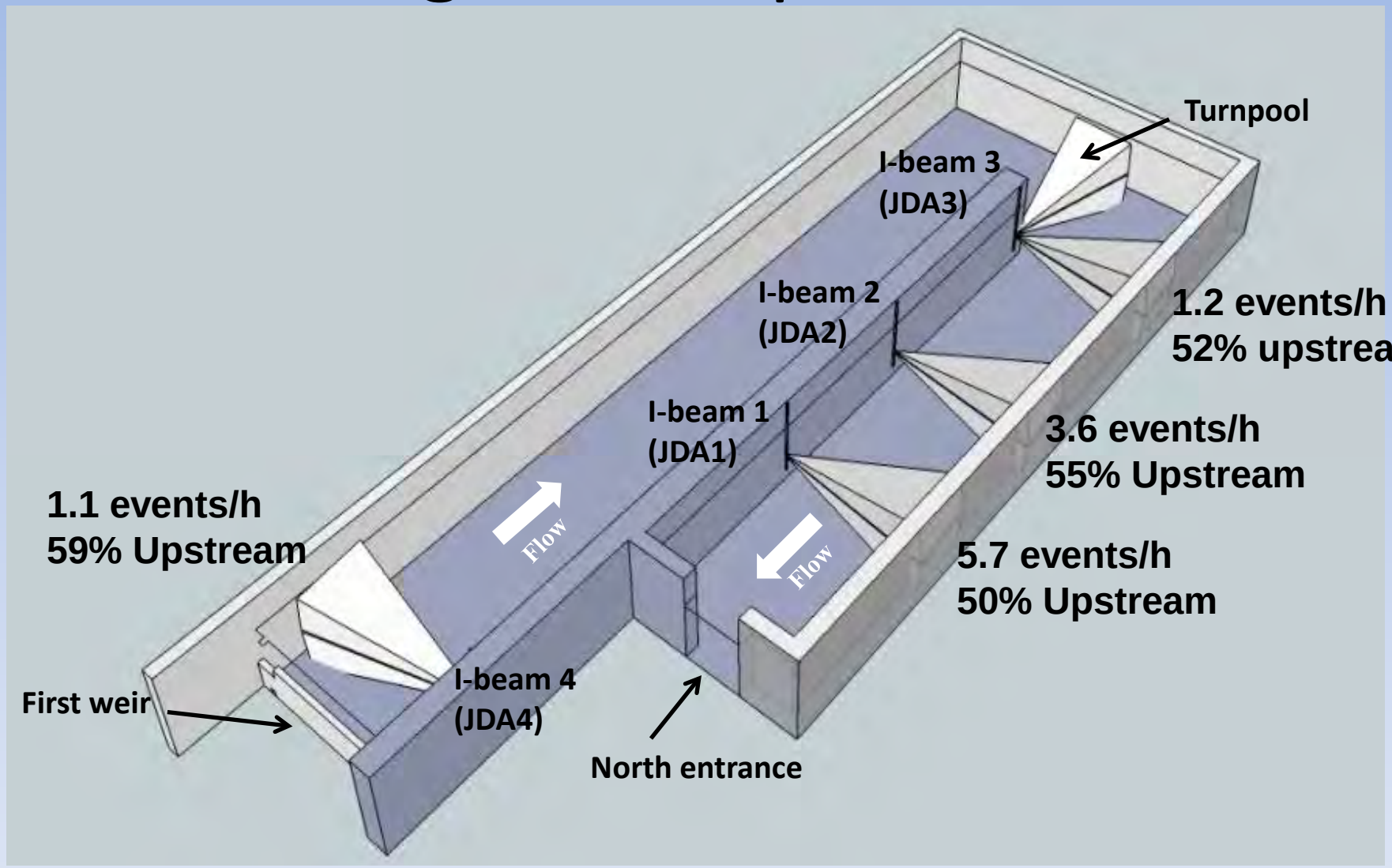
Longitudinal pattern



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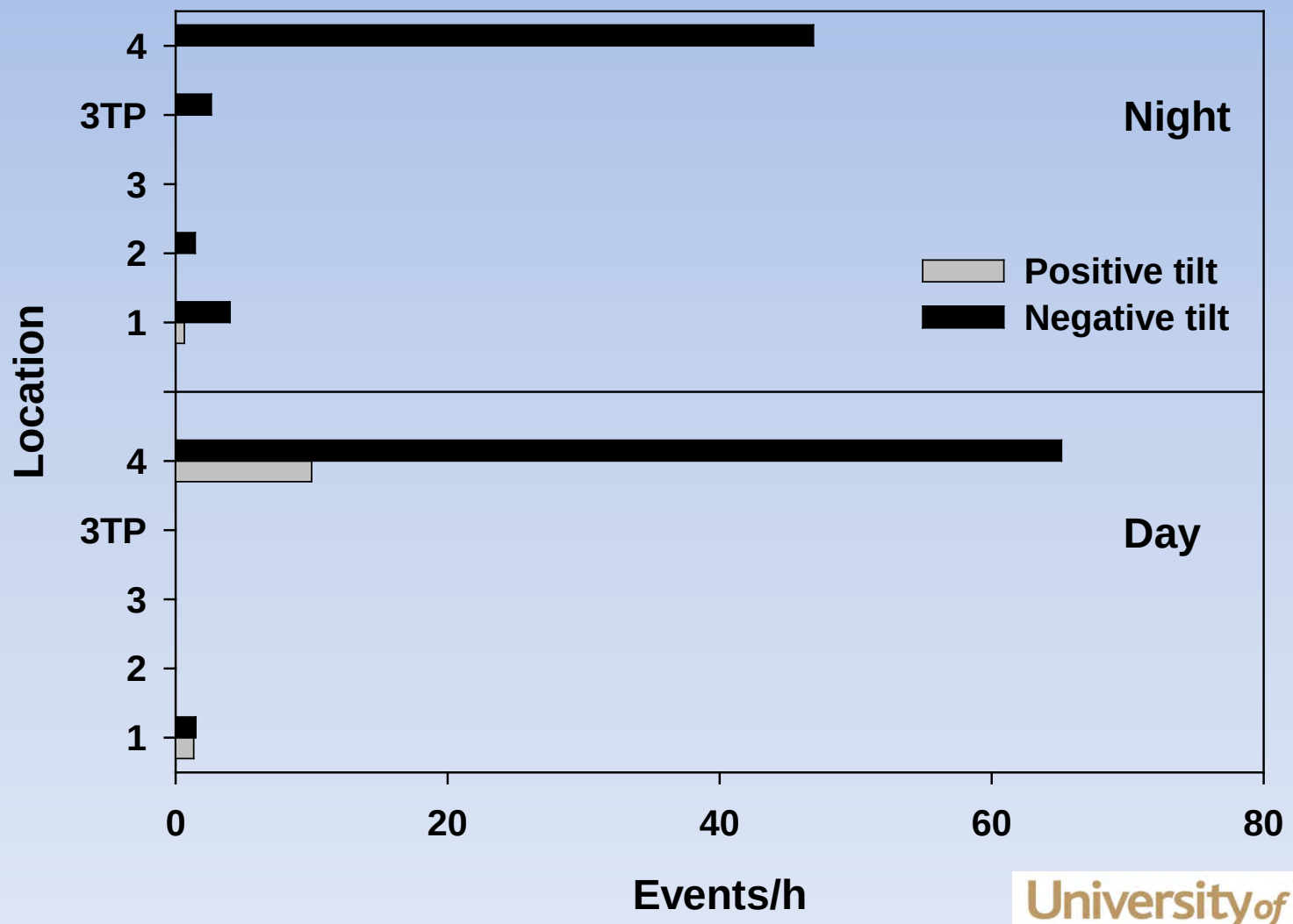
JD Cross Sections – Sturgeon Events Per Hour



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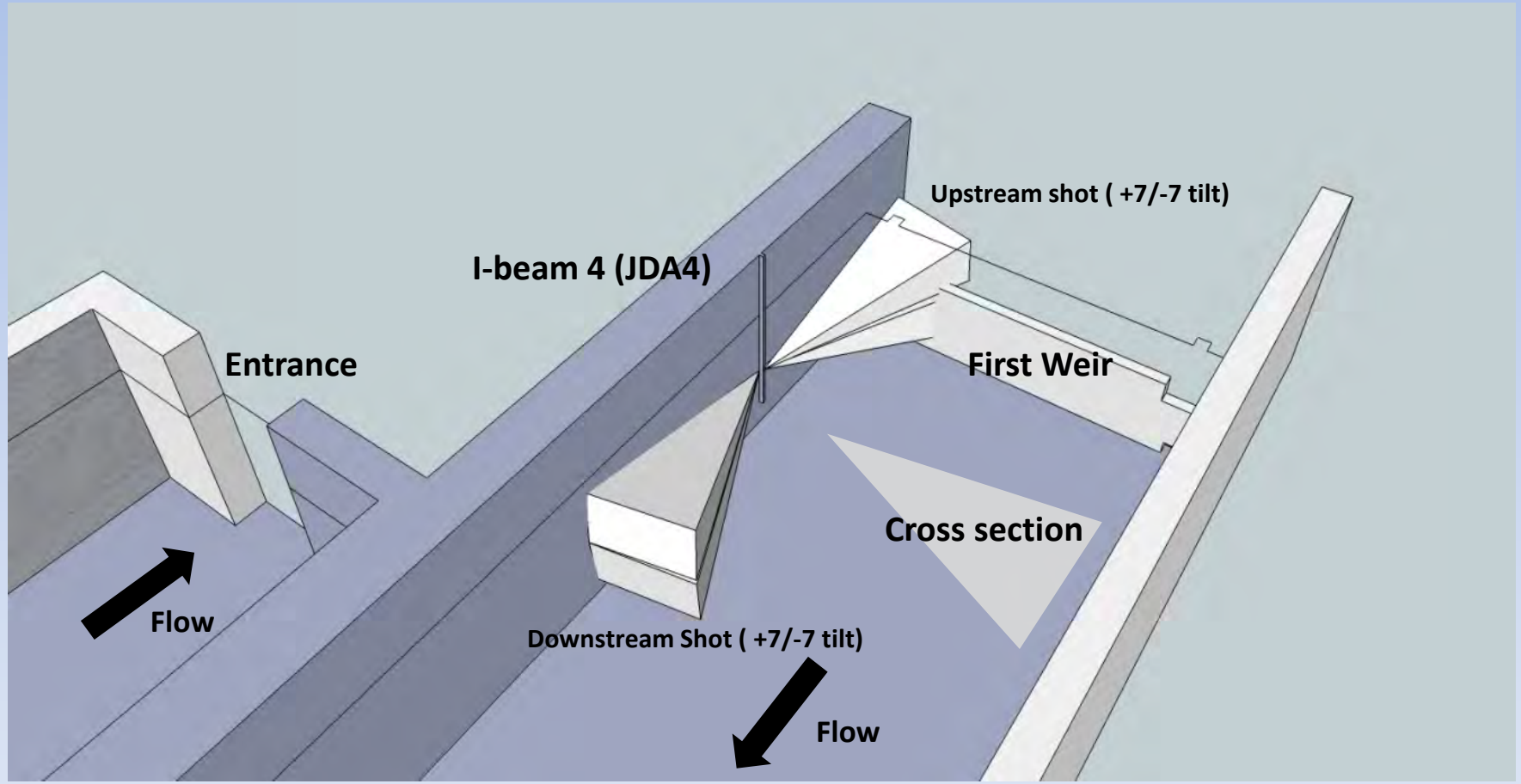
John Day Transition Pool



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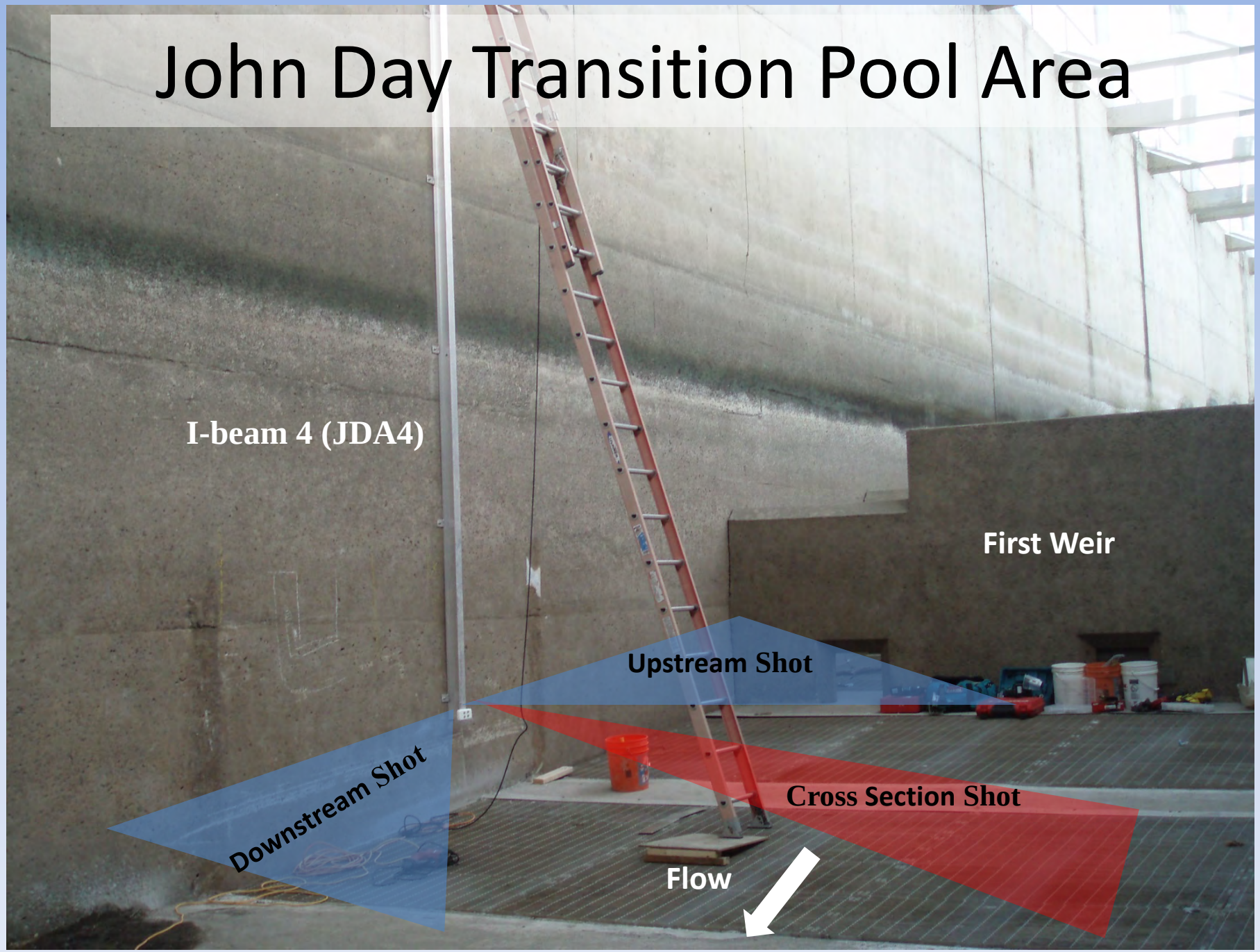
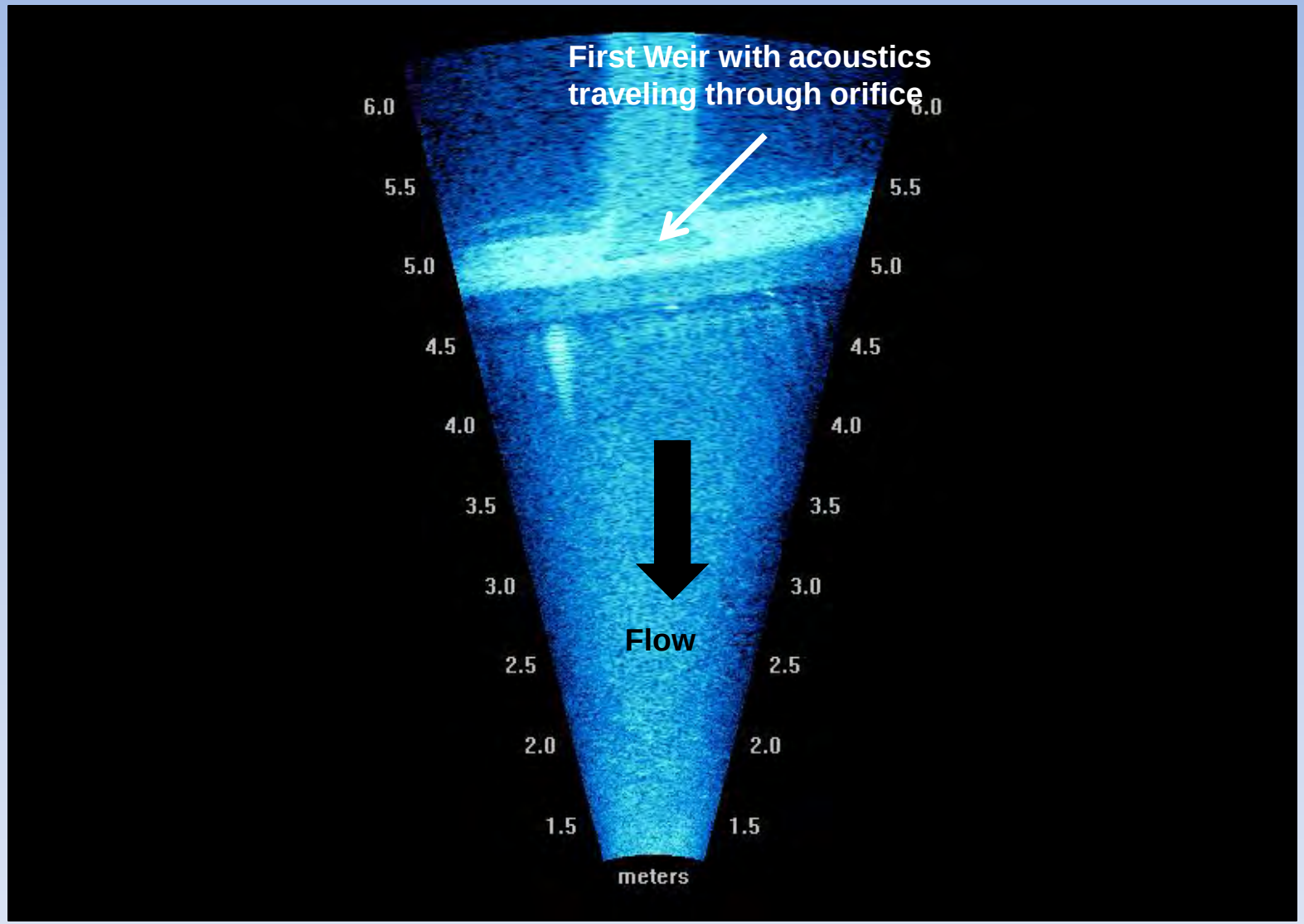
John Day Transition Pool Area



John Day Beam 4 Deployments



JDA4_TP_UP

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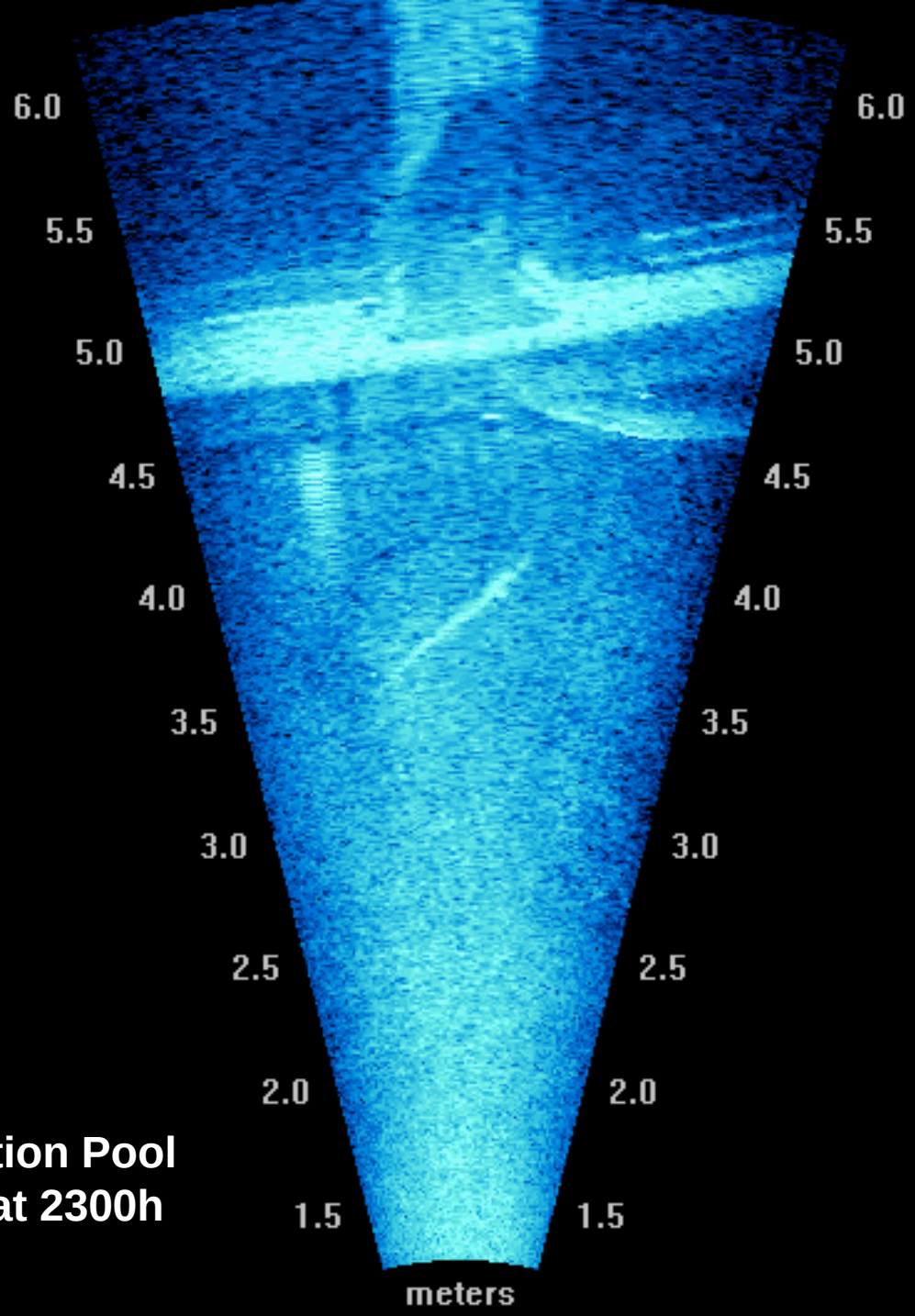
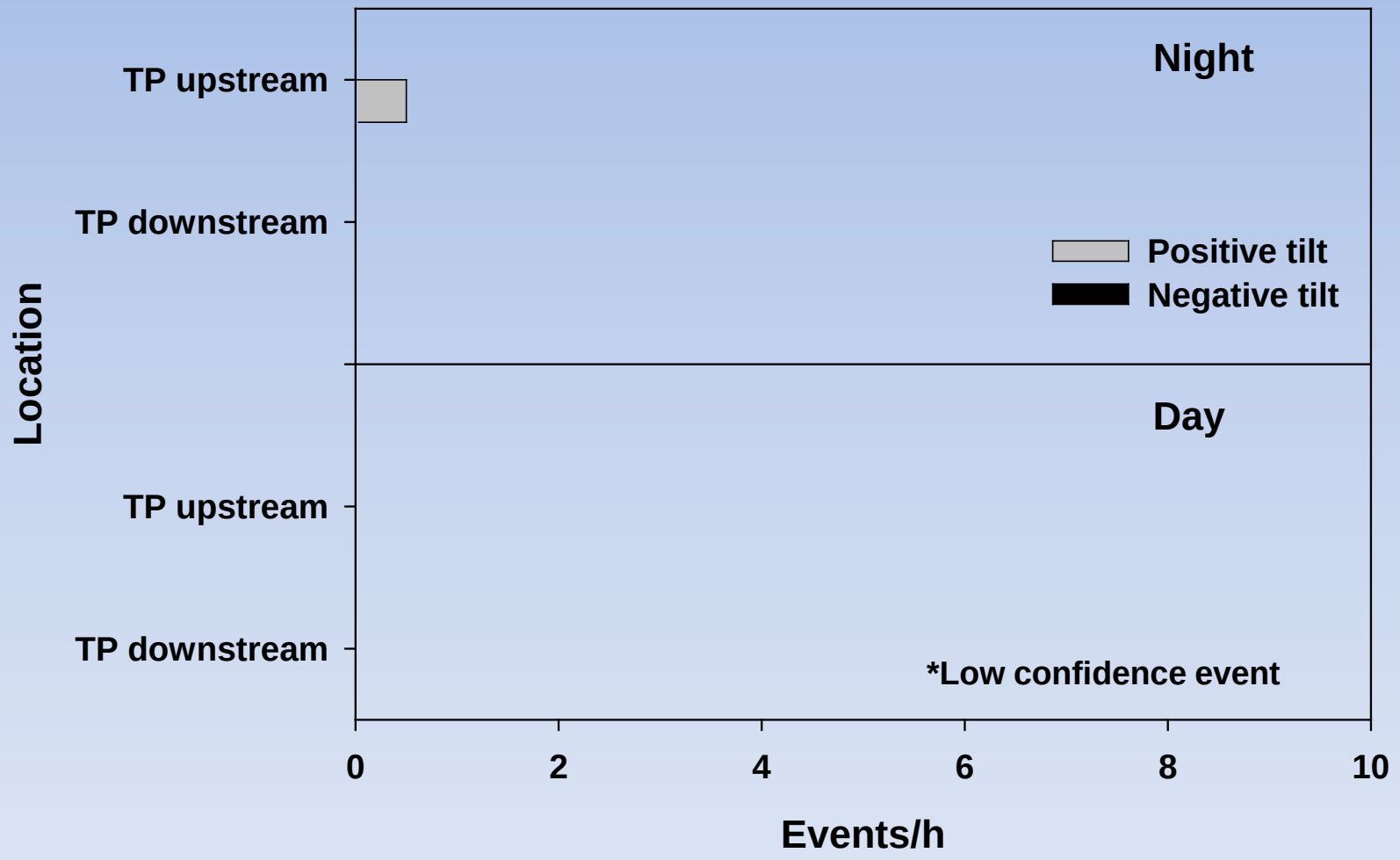


JD4 Transition Pool
August 11 at 2300h

JD4 Transition Pool – Lamprey Events Per Hour



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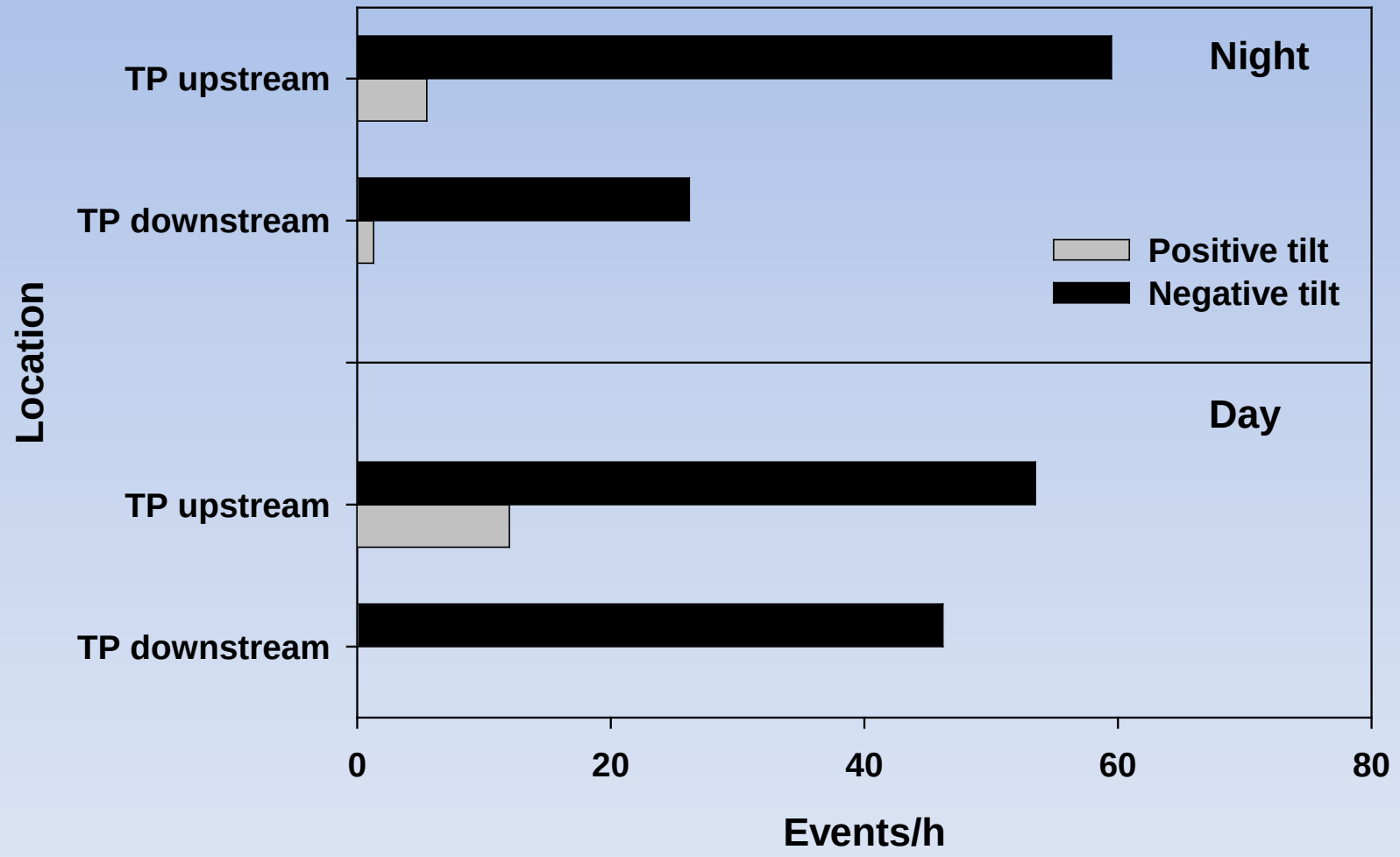
JD4 Transition Pool – Sturgeon Events Per Hour



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John Day Preliminary Results

- Upstream movement in bollards common
- Upstream movements in collection channel concentrated in lower water column
- Downstream movement in collection channel nearly as common, upper water column
- Decline in event rate upstream
- Sturgeon concentrated near first weir
- Very few lamprey at first weir

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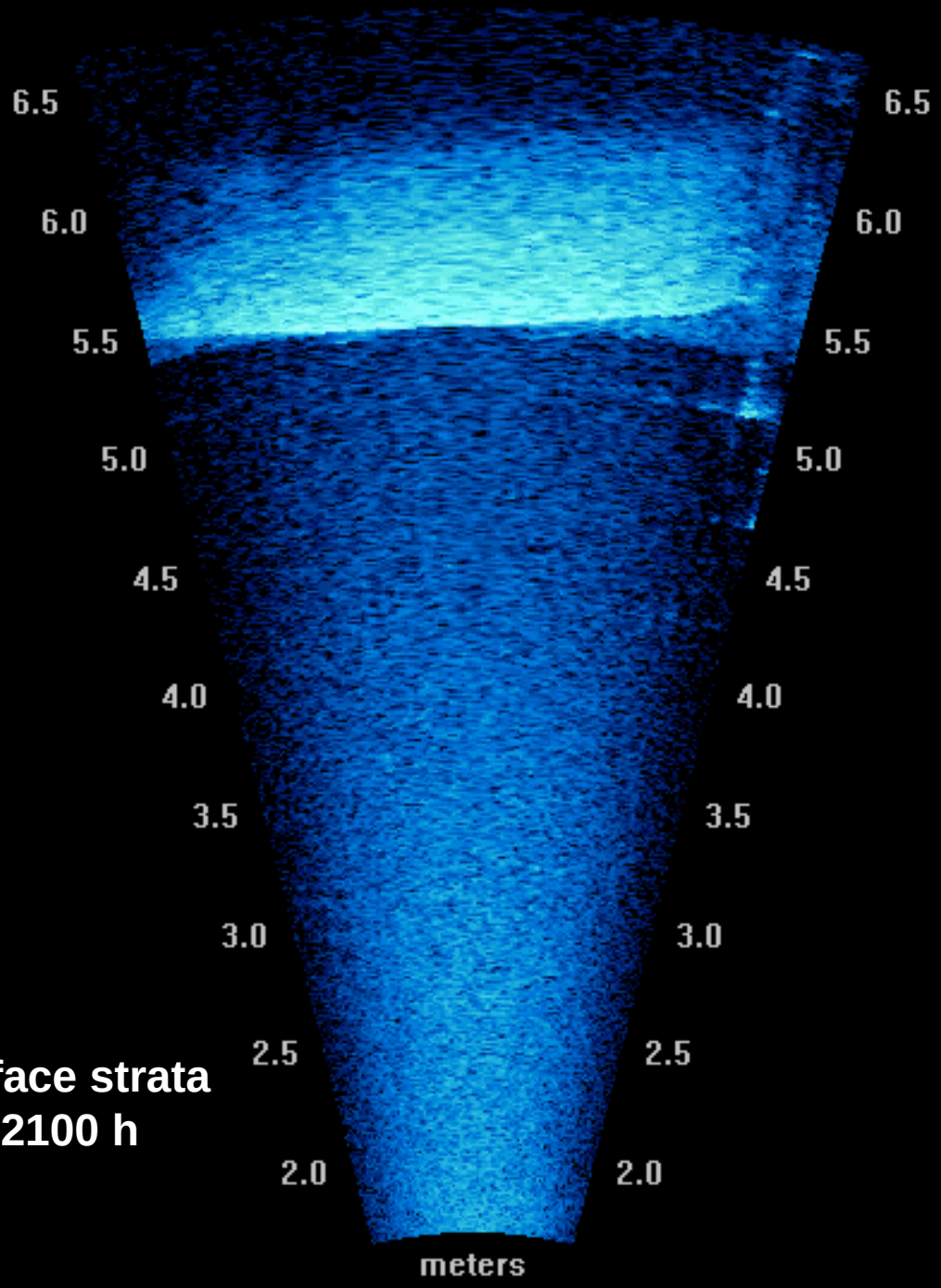
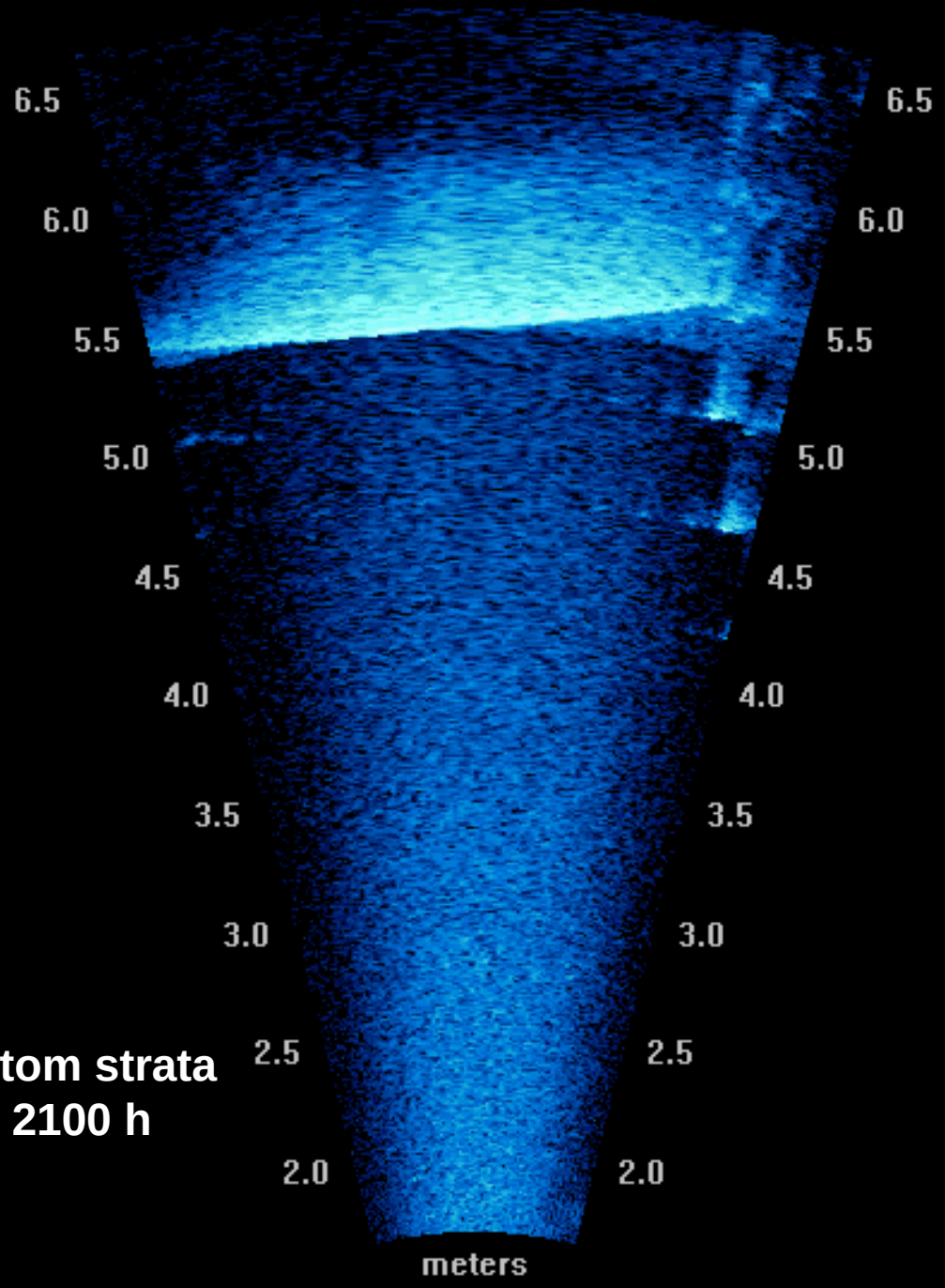
Questions?

Thanks to R. Budwig, B. Basham, & N. Bradshaw, UI CER

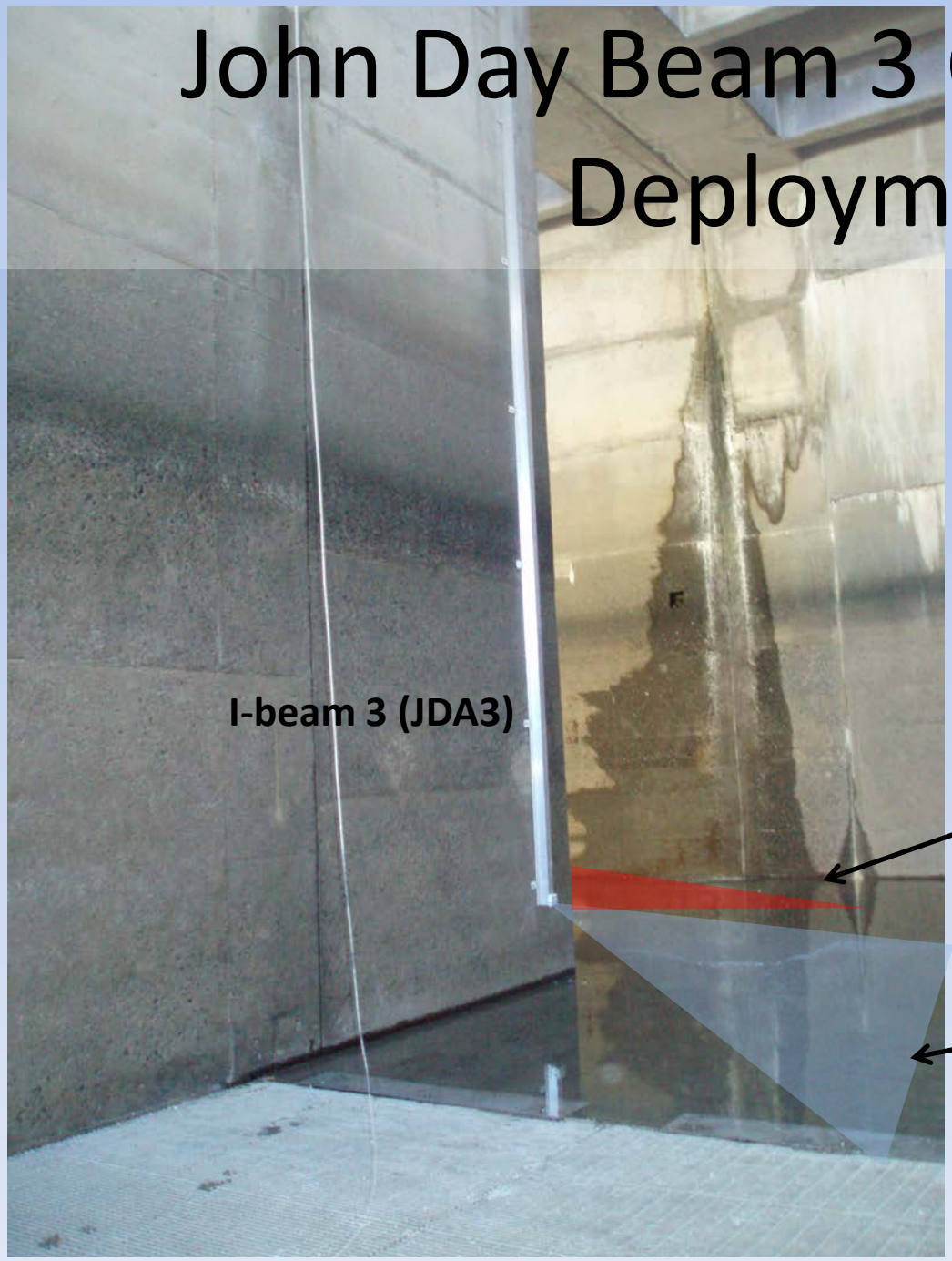


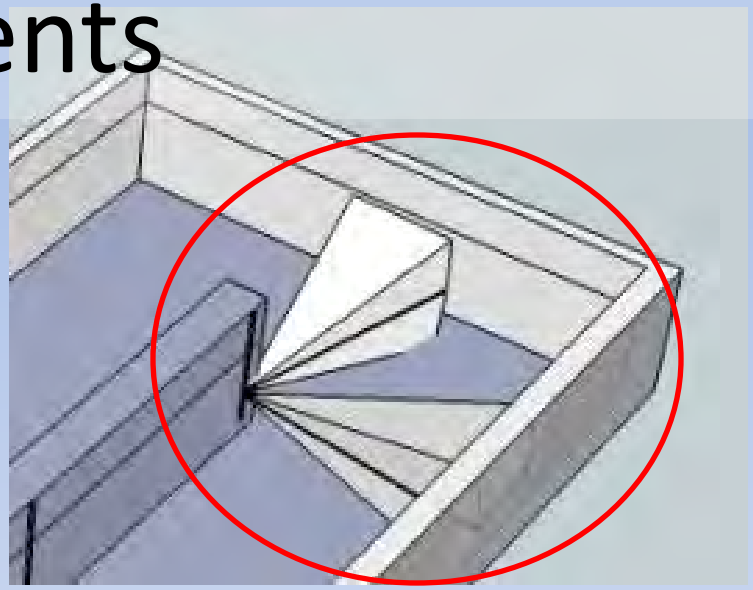
NDE – Surface strata
June 21 at 2100 h



NDE – Bottom strata
June 20 at 2100 h

John Day Beam 3 Cross Section Deployments





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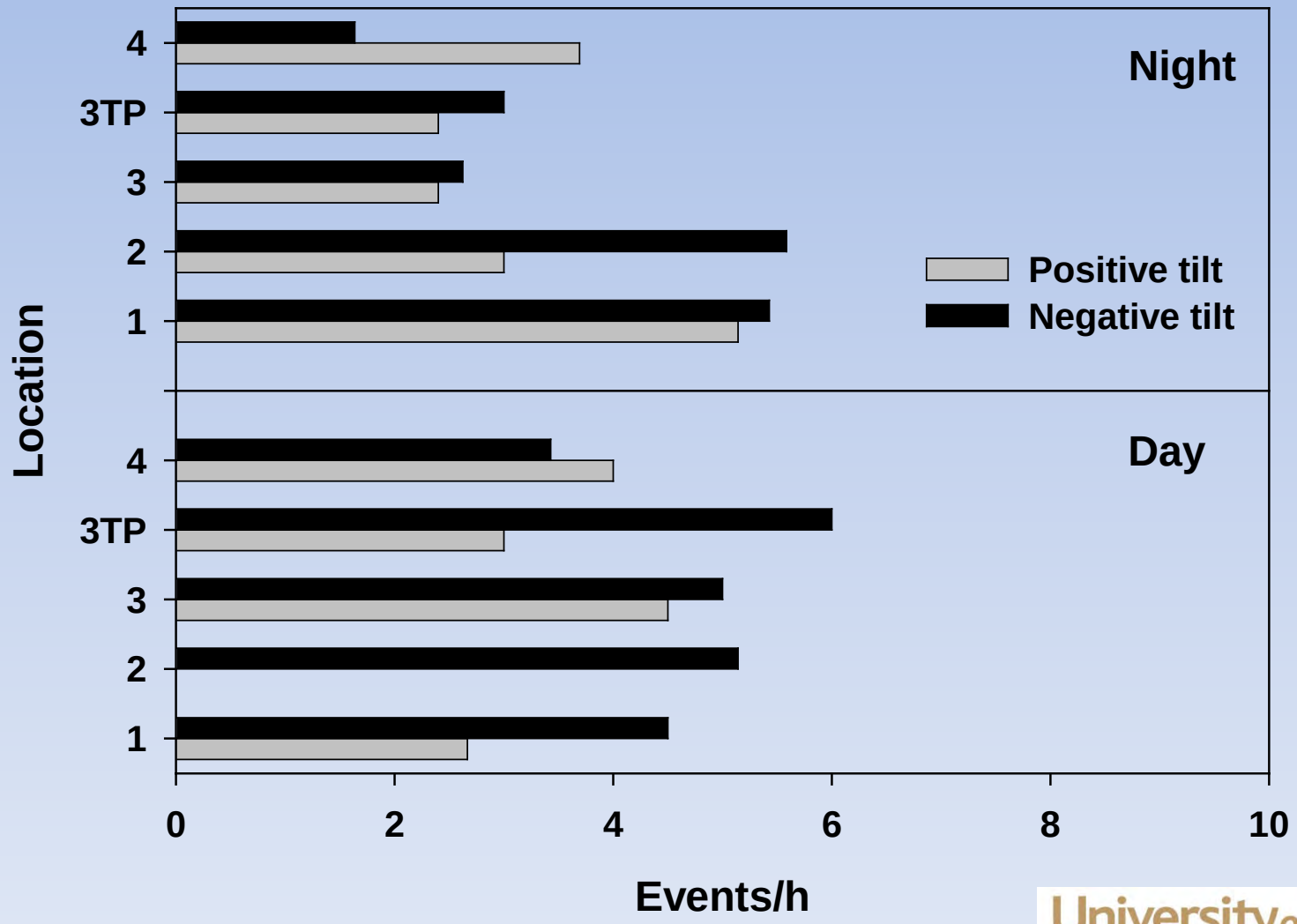
JD Cross Sections – Lamprey Events Per Hour



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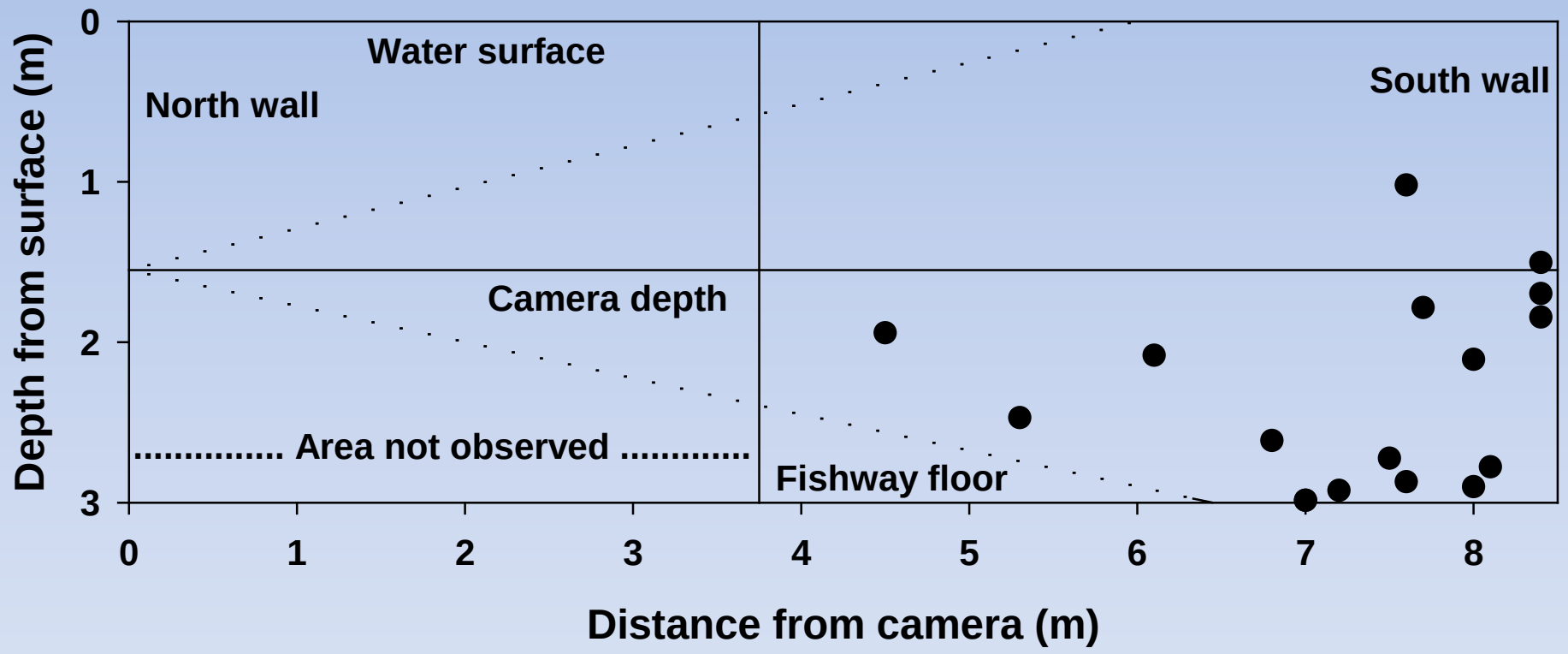
JD1 Cross Section Portrait Depth



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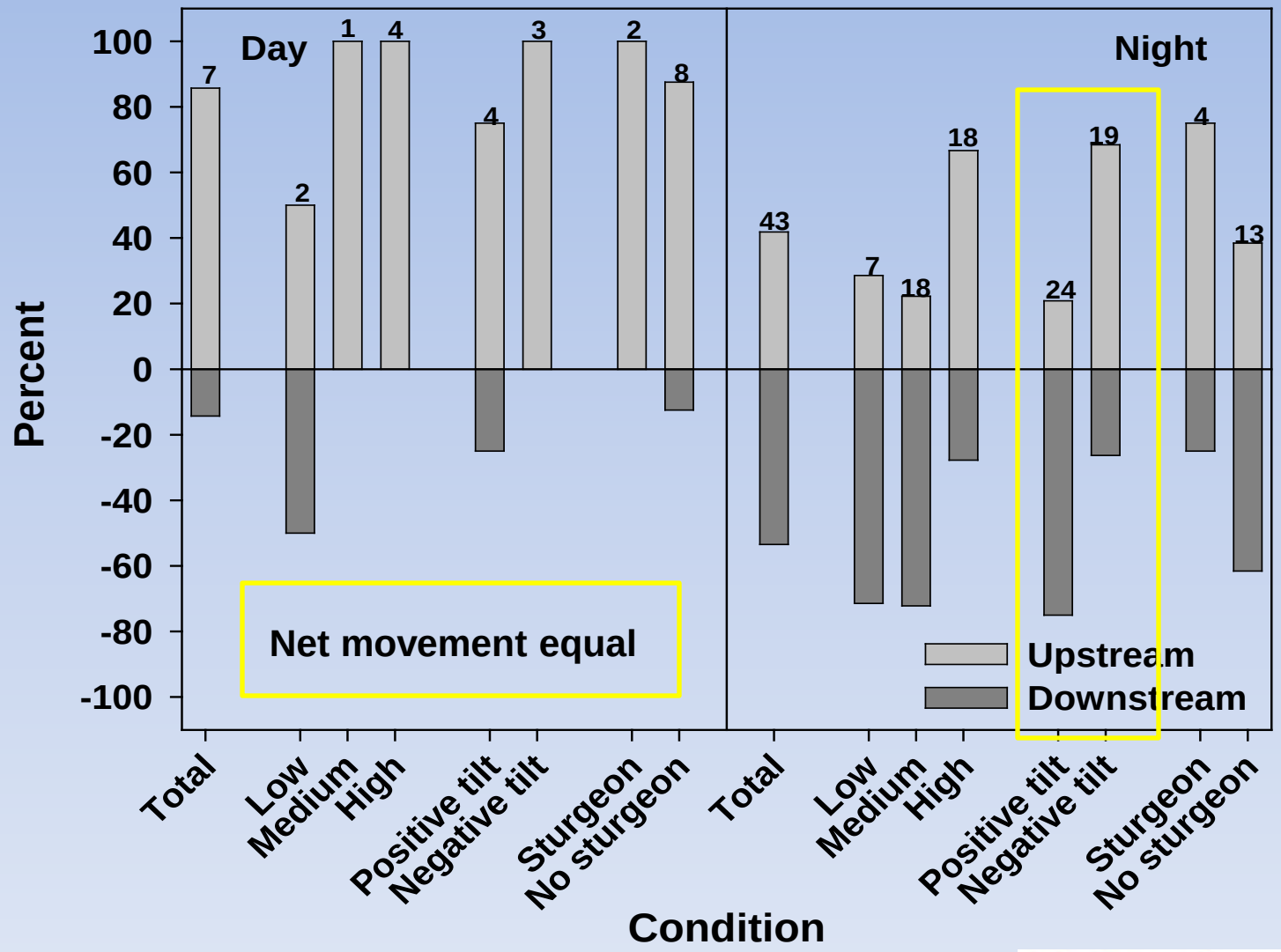
JD1 Cross Section – Net Movement



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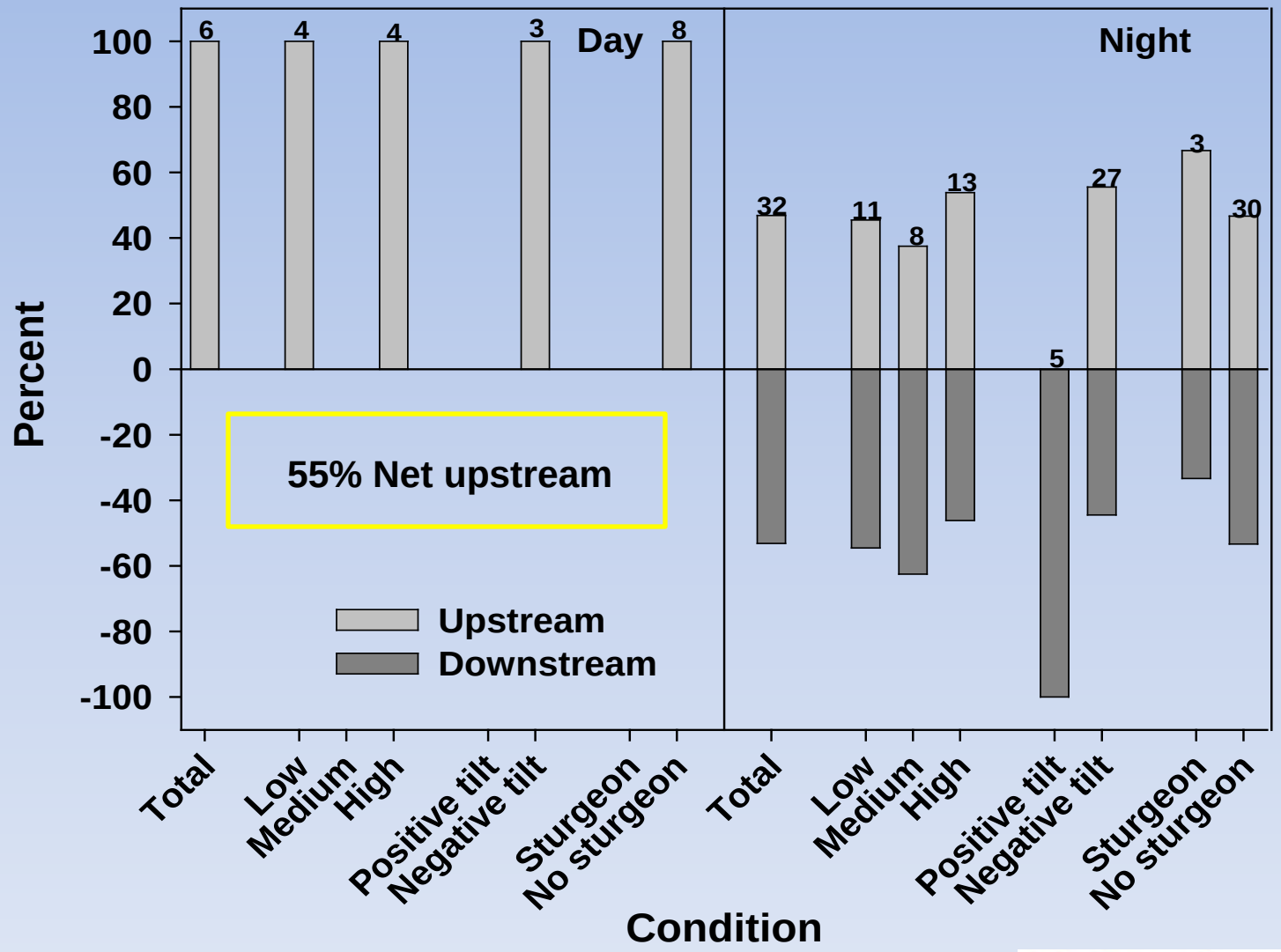
JD2 Cross Section – Net Movement



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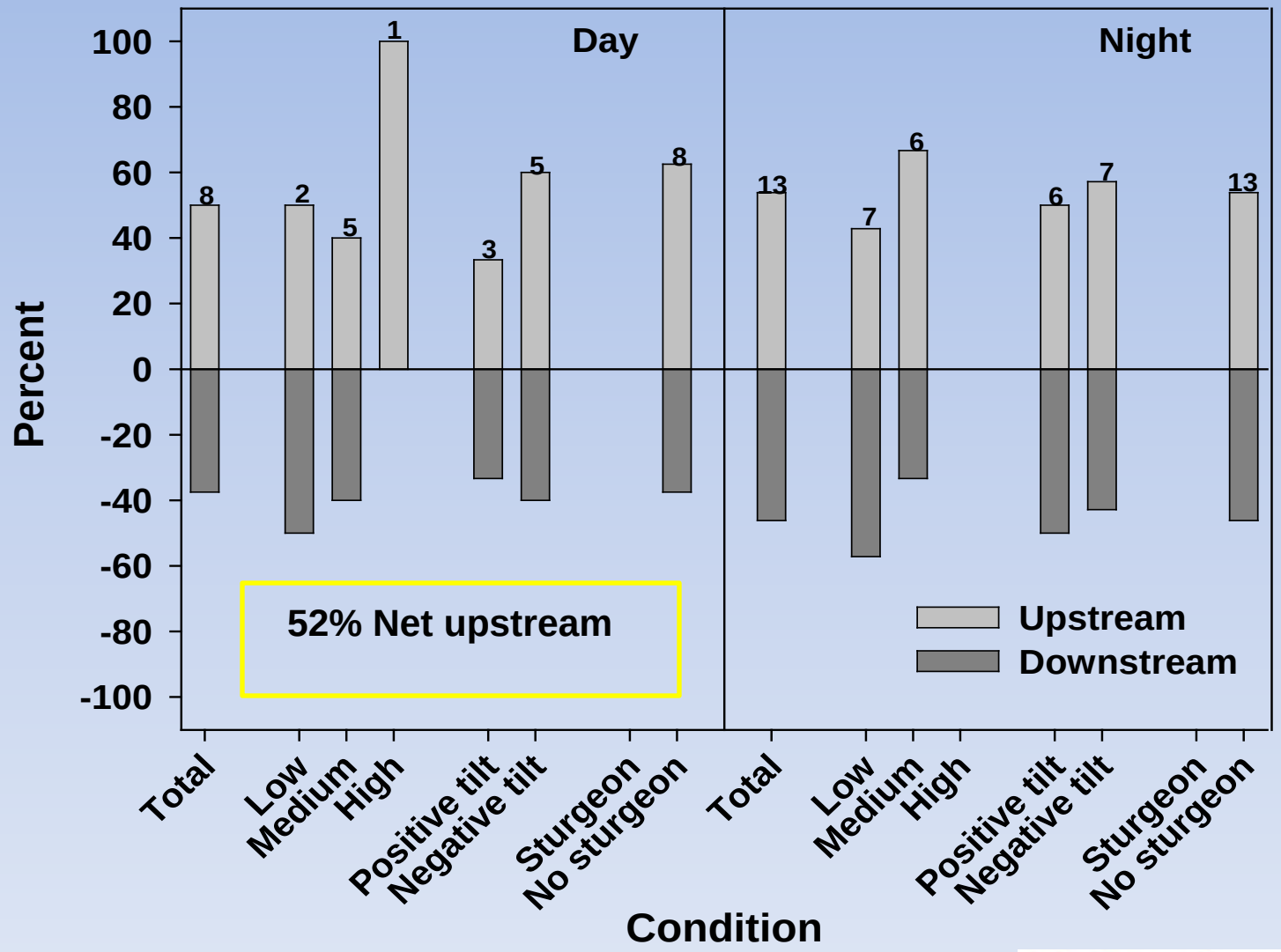
JD3 Cross Section – Net Movement



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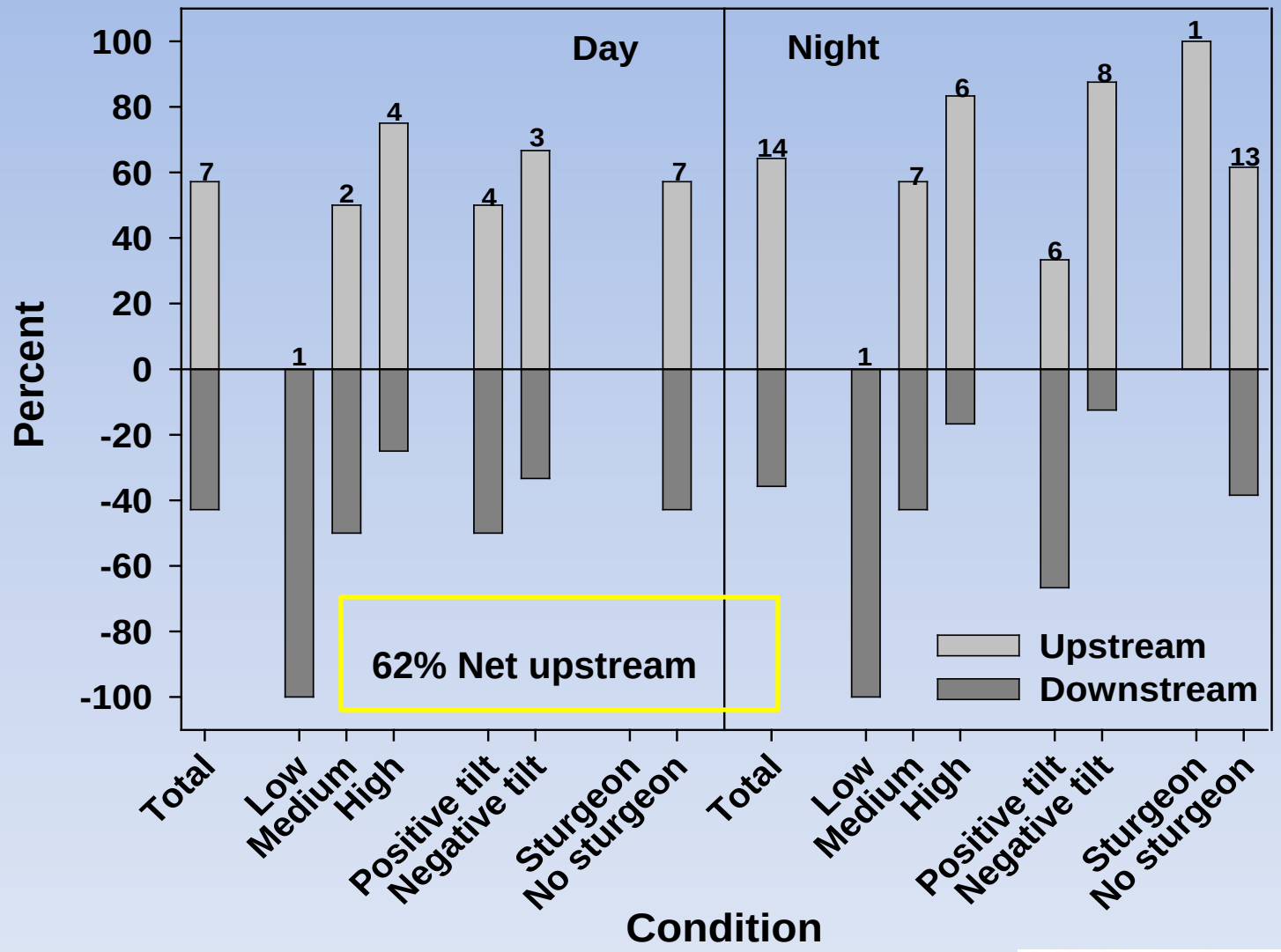
JD3 Turnpool Cross Section – Net Movement



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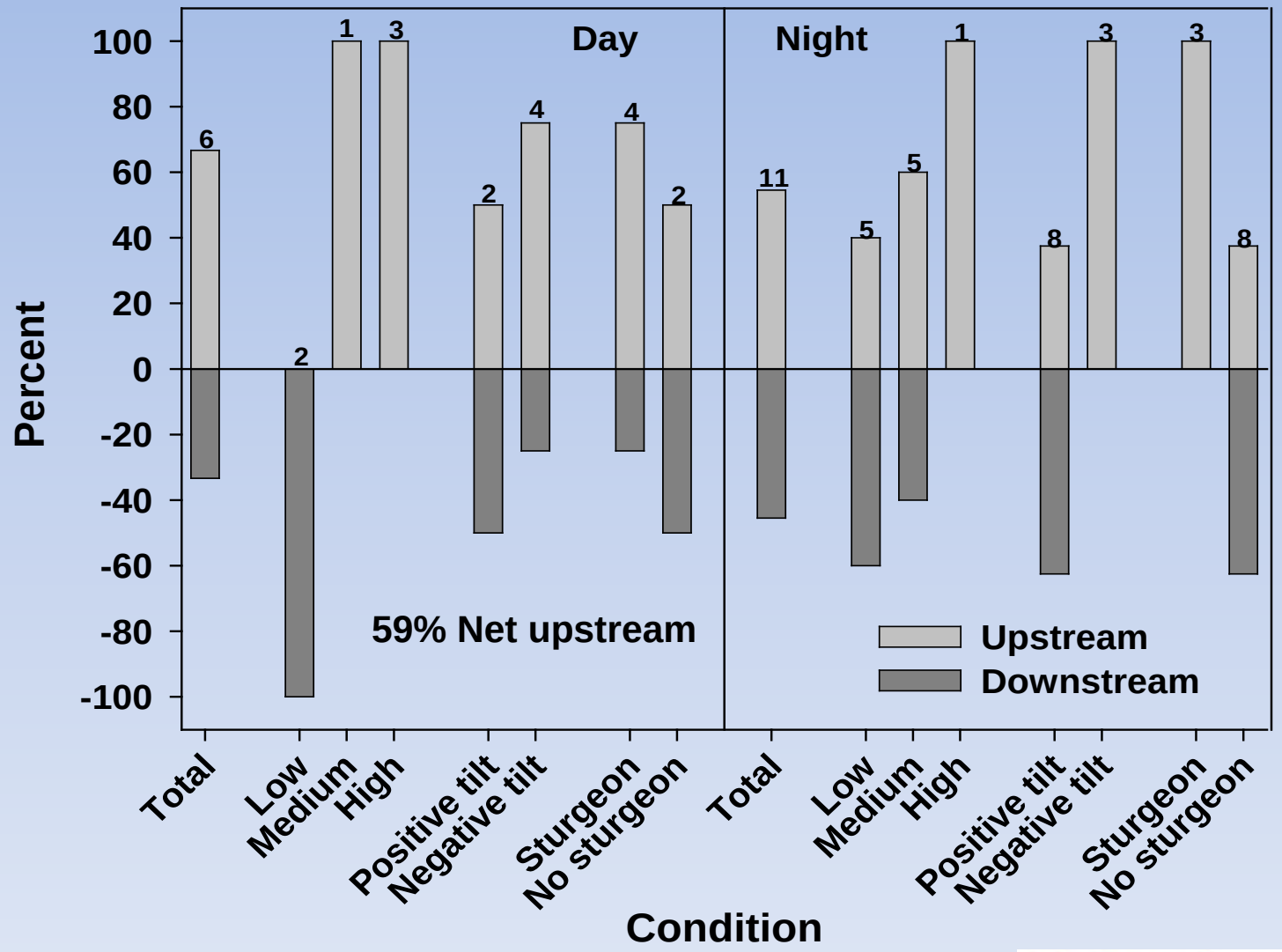
JD4 Cross Section – Net Movement



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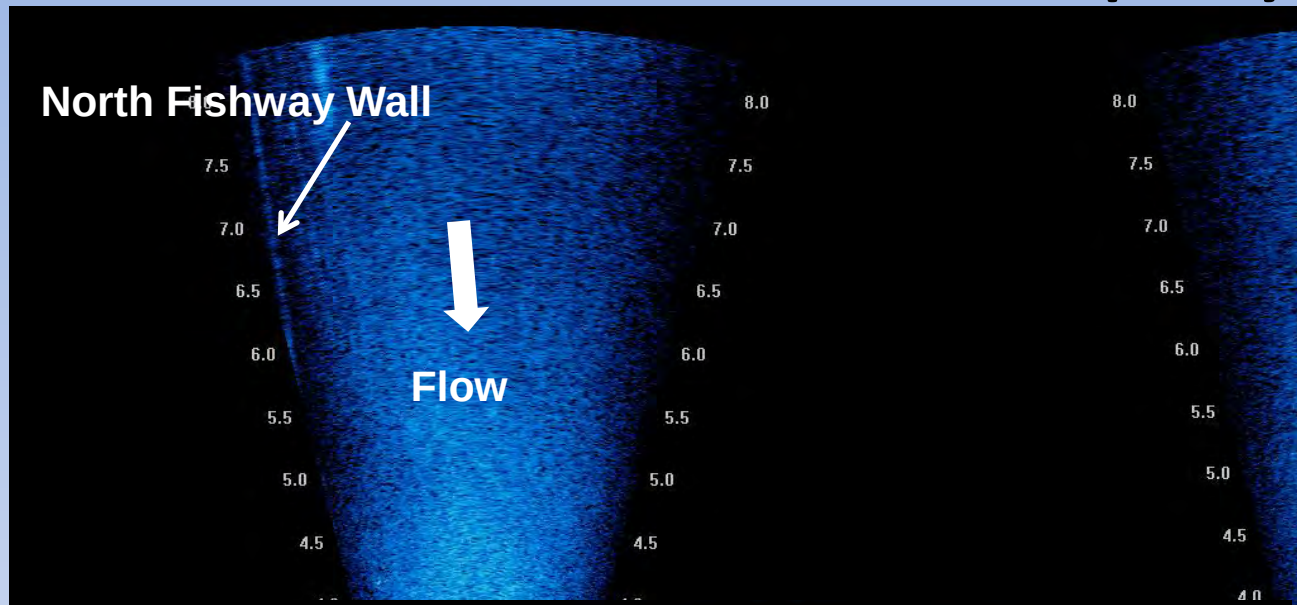
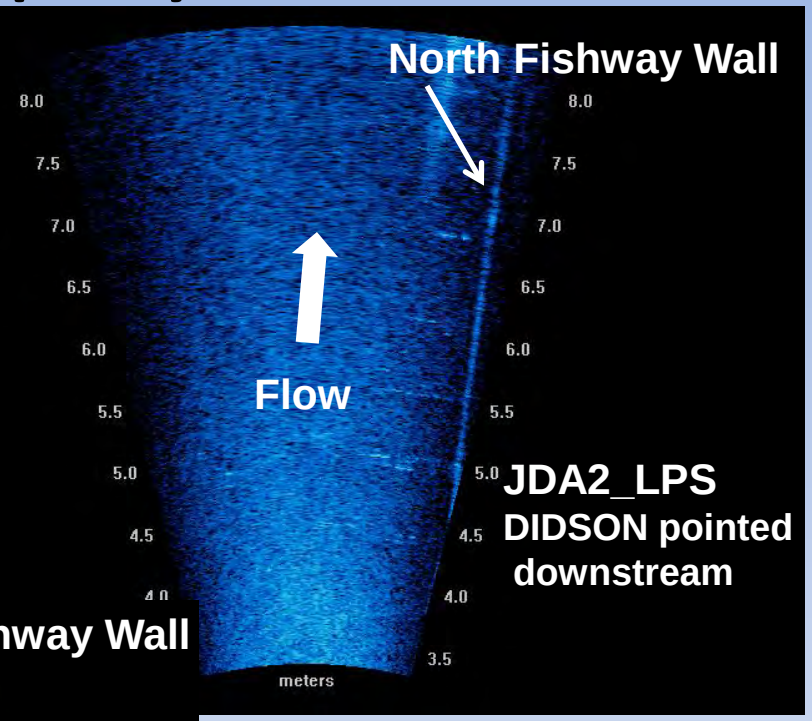
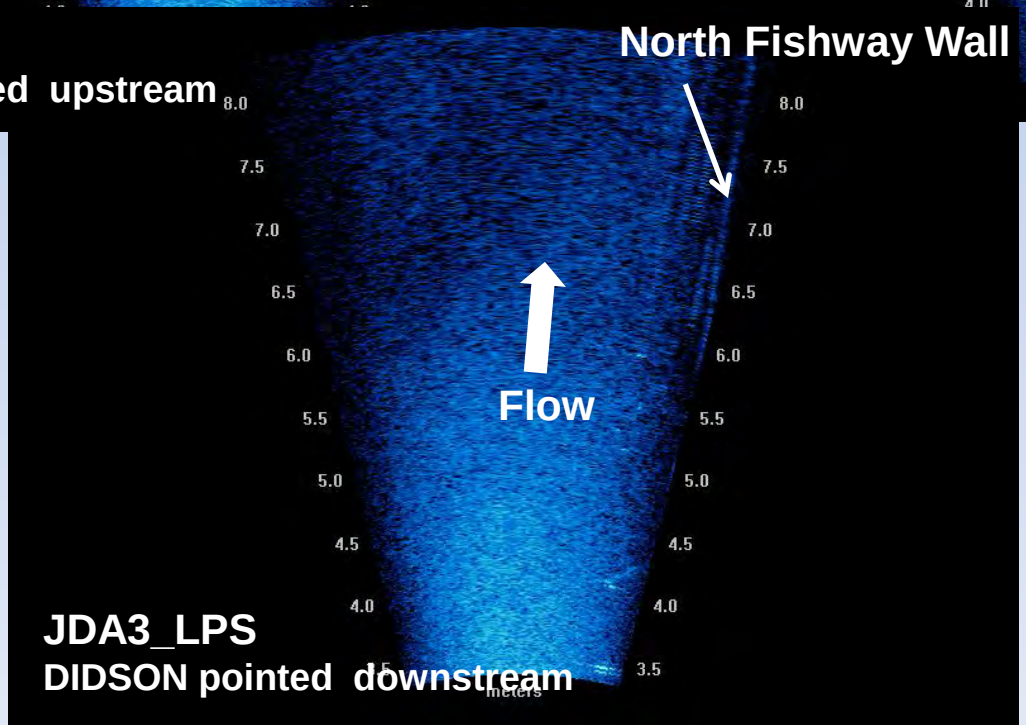
Alternate LPS Deployments



JDA1_LPS
DIDSON pointed upstream



JDA2_LPS
DIDSON pointed downstream



JDA3_LPS
DIDSON pointed downstream

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