Climate and Land Use Change Effects on Future Runoff Production & Transfer Mechanisms and Failure Probability of Dams in New England

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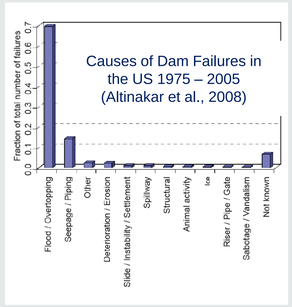
Dam Failure & Spillway Capacity

- Most dam failures are caused by overtopping and floods higher than spillway capacity
- Magnitude & frequency of floods exceeding spillway capacity can be used as failure probability indicators



Dam Risk & Spillway Capacity

Risk is product of *probability* and *consequences* of failure

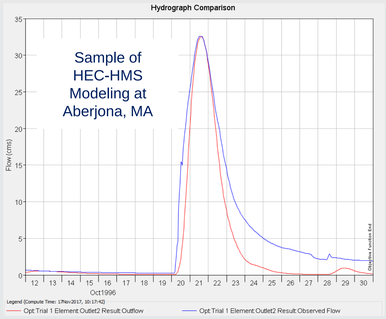
Hazard Class	Failure Consequences
Non-Menace	No anticipated loss of property or life
Low	Property loss
Significant	Significant loss of property and possible impacts to occupied structures and roads
High	Loss of life

Hazard Class	Inflow Design Flood*		
	NHDES		FERC
	Existing Dams	New Constructions	
Non-Menace	-	50-yr	-
Low	50-yr	100-yr	100-yr
Significant	100-yr	50% PMF	-
High	2.5x100-yr	PMF	PMF

* NHDES existing dams' regulations are based on Env-Wr 303.11
NHDES new dams' regulations are based on Env-Wr 403.04
FERC regulations are based on Federal Emergency Management Agency's guidelines

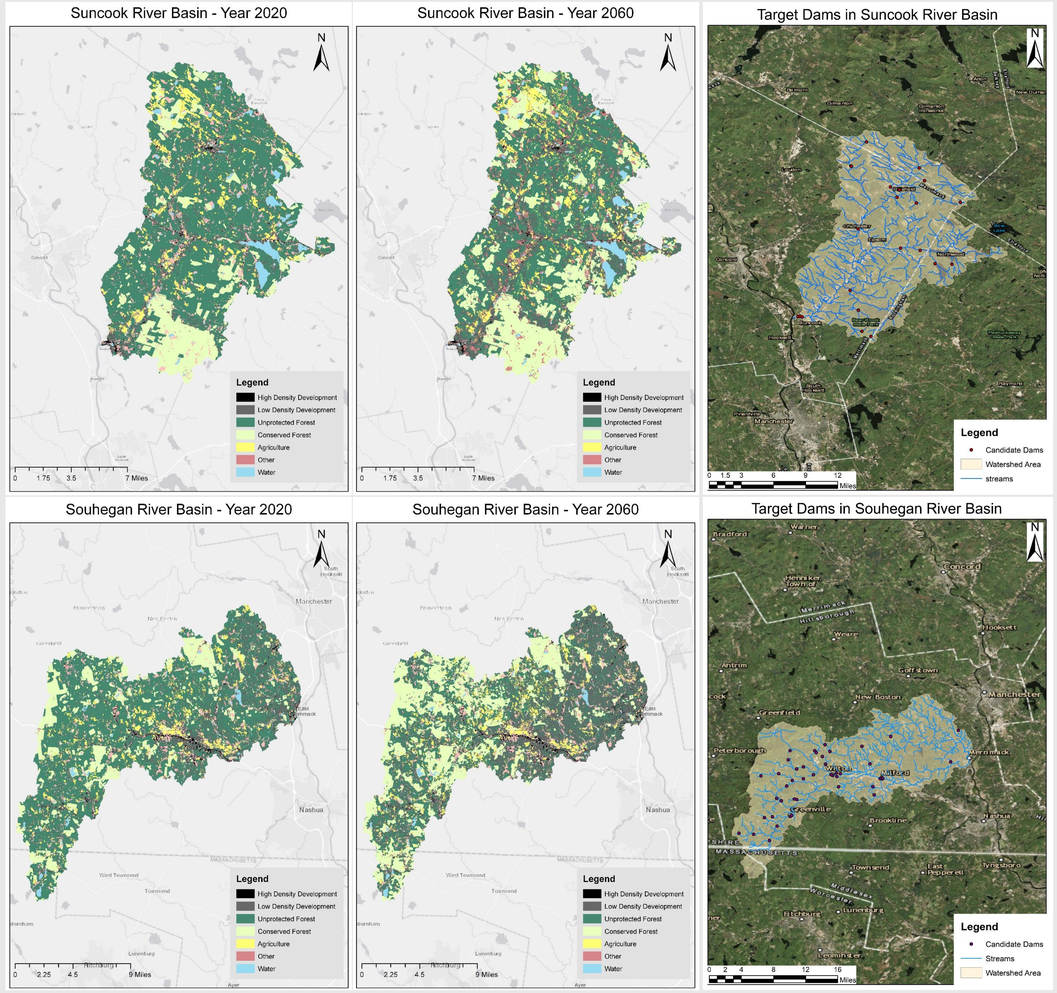
Hydrologic Modeling

- Rainfall-runoff modeling of dam basins in HEC-HMS is conducted to find flood peaks at dam sites using hourly rainfall data



Future Land Use

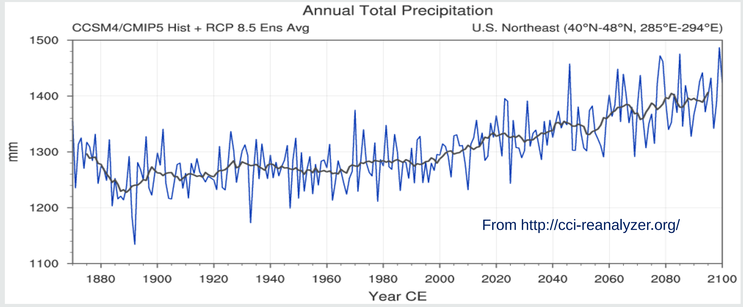
- The Souhegan and Suncook River Basins are chosen initially to be studied for their large land use changes



Future Land Use Projections in Suncook & Souhegan River Basins Based on Recent Trends (adopted from McBride et al., 2017) and Location of Target Dams

Future Climate

- Data of future climate scenario are available at the UNH "Data Discovery Center" website as an outcome of the NH EPSCoR "Ecosystems & Society Project".
- Temporal resolution of precipitation and temperature used for modeling is hourly.



Target Dams

Information of Target Dams in Suncook River Basin

No.	Hazard Class	Name	L (ft)	H (ft)	Spillway Capacity (cfs)
1	L	BEAR HILL POND DAM	310	7	35
2	L	PLEASANT LAKE DAM	225	7	94
3	L	CLARKS POND DAM	130	8	126
4	L	HAYES MARSH DAM	240	10	195
5	L	DEER MEADOW POND DAM	100	15	350
6	H	BERRY POND DAM	260	18.35	353
7	L	HALL MOUNTAIN MARSH DAM	40	13	494
8	H	SANBORN POND GRIST MILL DAM	265	16	554
9	H	SANBORN SAWMILL DAM	156	13	565
10	L	ADAMS POND DAM	150	10	677

No.	Hazard Class	Name	L (ft)	H (ft)	Spillway Capacity (cfs)
11	H	NORTHWOOD LAKE DAM	169	13	728
12	S	GULCH MOUNTAIN POND DAM	600	14.5	1647
13	H	PEMBROKE DAM	108	25.6	1848
14	L	CASS POND DAM	140	10	1961
15	L	ROLLINS POND DAM	192	17	2000
16	H	PITTSFIELD MILL DAM	470	21	4012
17	H	BARNSTEAD PARADE DAM	150	16	7627
18	S	WEBSTER MILL DAM	250	18	11010
19	L	CHINA MILL DAM	275	29	16160

Information of Target Dams in Souhegan River Basin

No.	Hazard Class	Name	L (ft)	H (ft)	Spillwa Capacity (cfs)
1	L	KAMEN GEO-THERMAL POND DAM	445	24	16
2	L	PETERS FARM POND DAM	173	9	16
3	L	HARTSHORN BROOK II DAM	100	8	24
4	L	COMPRESSOR POND DAM	210	24	29
5	L	CURTIS BROOK DAM	60	10	36
6	L	PRATT POND DAM	150	6.5	36
7	H	WS PACKAGING DAM	360	15	72
8	L	BURTON POND DAM	160	14	75
9	L	FROG POND DAM	190	15	123
10	L	LEIGHTON POND DAM	100	10	162
11	L	BATCHELDER POND DAM	170	12	177
12	L	MEADOW WOOD POND DAM	125	15	210
13	L	ERB WILDLIFE POND DAM	150	20	295
14	L	RAILROAD POND DAM	55.75	12	541
15	L	FREESTYLE FARM DAM	200	11.5	566
16	L	BLOOD BROOK DAM	260	18	575
17	L	OSGOOD POND DAM	150	9	580
18	L	FRYES MEASURE MILL DAM	170	15	595
19	L	HARTSHORN POND DAM	121	14.9	658

No.	Hazard Class	Name	L (ft)	H (ft)	Spillway Capacity (cfs)
20	L	CURTIS BROOK DAM	100	12	856
21	L	SOUHEGAN RIVER SITE 13 DAM	1120	13.5	1197
22	L	WATERLOOM POND DAM	214	22.5	1950
23	H	SOUHEGAN RIVER SITE 33 DAM	510	21	2100
24	H	SOUHEGAN RIVER SITE 28 DAM	590	29	2521
25	L	OTIS FALLS DAM	150	27	3130
26	H	SOUHEGAN SITE 14 DAM	1510	28.3	4700
27	L	WILTON HYDRO DAM	125	17	5420
28	H	SOUHEGAN RIVER SITE 10A DAM	1281	59	5500
29	H	SOUHEGAN SITE 8 DAM	570	25	7030
30	L	GOLDMAN DAM	180	12	7364
31	H	SOUHEGAN RIVER SITE 12A SOUTH	290	37.7	8469
32	H	SOUHEGAN RIVER SITE 12A NORTH DIKE	1185	38.7	8469
33	H	SOUHEGAN RIVER SITE 35 DAM	1209	30	9135
34	L	PINE VALLEY MILL DAM	200	23	11400
35	L	MCLANE DAM	200	18.6	11707
36	H	SOUHEGAN RIVER SITE 26 DAM	675	79	12544
37	H	SOUHEGAN RIVER SITE 25B DAM	695	74	15800
38	H	SOUHEGAN RIVER SITE19 DAM	1250	35.5	16463

Final Intended Outcomes

This research is based on the hypothesis that future failure probability of NE dams will change due to climate and land use change. The hypothesis for this research will be tested by developing the following sets of data:

- Historic flood flow at dam sites,
- Spillway capacity of dams,
- Future high flow regimes,
- Suitability of spillway design with respect to the past and future high flow regimes.
- Future changes in failure probability of dams