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Hoover Wide Head Range Runner Replacement Prioritization

January 2026

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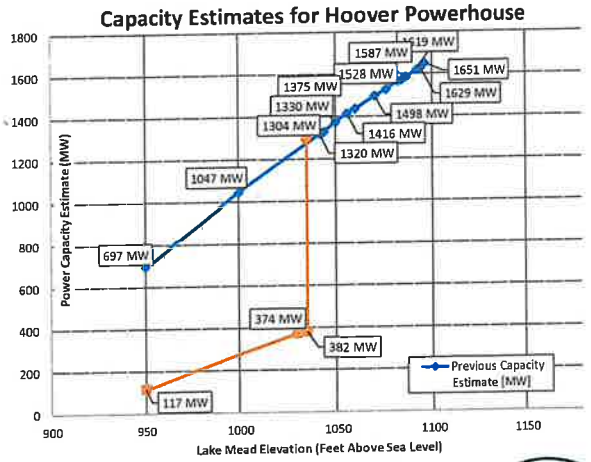
Background

- Wide Head Turbines Runners are designed to operate at a wider range of lake elevations "head" and are more efficient across a wider range
- Hoover Dam currently has 5 wide head runners (A1, A8, N5, N6 and N8)
- Below lake elevations 1035 ft., it is estimated the 12 older runners will not be able to operate without significant damage and significantly reduced generation



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Prioritization Considerations

- Turbine Runner condition and age
- Wicket Gate condition and age
- Cost (units with heavier runners cost more)
- Cost (model test cost $2.5M per "type")
- Design Head Range
- Time until operational
- Number of wide head runners per penstock

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Existing Unit Condition

Unit	Header	Wide Head Range Runner?	Number of Wide Head Range Runners on Header	Wicket Gate Cavitation	Wicket Gate Age	Runner Cavitation	Age
N1	NL		1	Unknown	7	Unknown - Assumed Light	37
N2	NU		2	Very Poor	37	Light	37
N3	NL		1	Good	14	Fair to light	37
N4	NU		2	Good	15	Light	37
N7	NL		1	Fair	17	Light	42
A2	AL		0	Good	18	Fair	36
A3	AL		0	Fair	33	Fair	33
A4	AU		2	Poor	33	Fair	33
A5	AL		0	Very Poor	43	Fair	43
A6	AU		2	Good	15	Fair	43
A7	AL		0	Good	18	Light	37
A8	AU	Y	2	Good	11	Inoperable	11
A9	AU		2	Good	3	Very Poor	34

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Cost Comparison

	Unit	Condition Score	Model Test Group	Model Test Cost 1	Runner Cost (Assuming $68/lb)	WG Cost	Machine & Installation Cost	Total Estimated Cost
	A8	20	6	$ 2,500,000	$ 1,840,828	See Note 2	$ 2,400,000	$ 6,740,828
	A9	13	7	$ 2,500,000	$ 1,798,600	See Note 2	$ 2,400,000	$ 6,698,600
	A3	22	4	$ 1,250,000	$ 3,597,200	$ 2,200,000	$ 2,500,000	$ 9,547,200
	A4	19	4	$ 1,250,000	$ 3,597,200	$ 2,200,000	$ 2,500,000	$ 9,547,200
4	A5	26	5	$ 1,250,000	$ 5,474,000	$ 2,200,000	$ 2,500,000	$ 11,424,000
	A6	14	5	$ 1,250,000	$ 5,474,000	$ 2,200,000	$ 2,500,000	$ 11,424,000
	A2	15	3	See Note 3	$ 4,950,060	See Note 2	$ 2,500,000	$ 7,450,060
4	N2	14	1	$ 1,250,000	$ 5,958,840	$ 2,200,000	$ 2,500,000	$ 11,908,840
	N3	10	1	$ 1,250,000	$ 5,958,840	See Note 2	$ 2,500,000	$ 9,708,840
	A7	9	5	$ -	$ 5,474,000	See Note 2	$ 2,500,000	$ 7,974,000
	N1	5	1	$ -	$ 5,958,840	See Note 2	$ 2,500,000	$ 8,458,840
	N4	4	1	$ -	$ 5,958,840	See Note 2	$ 2,500,000	$ 8,458,840
	N7	6	3	See Note 3	$ 4,950,060	See Note 2	$ 2,500,000	$ 7,450,060

Notes:

1 Model Test Cost per Test Group is estimated to be $2,500,000.

2 Wicket gates are relatively new and in good condition.
Runner design will include existing wicket gate dimensions.

3 Can save model test cost by using 10-year old design from existing on site.

4 Wicket gate replacement imminent

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Recommendations

- Units A3 and A4
  - Wicket Gates and Runners are 33 years old and ready for replacement
  - Currently operating outside design head range
- Units A5 and A6
  - A5 Wicket Gates are 43 years old and ready for replacement
  - Both Runners are 43 years old
- Units A2
  - Currently operating outside design head range
  - Could use A1 design to save model cost and 10 months
- Units N2 and N3
  - N2 Wicket Gates need replaced
  - Both Runners are 37 years old
- Units A8 and A9 (Awaiting Additional Information)
  - A8 is inoperable due to damage
  - A9 has cavitation damage

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Timeline

- TSC Developing Technical Specification - FY 2026
- Award – FY 2027*
- Fabricate Runner(s) FY 2031
- Installation FY 2032
- Monitor Hydrology Conditions - Continuous

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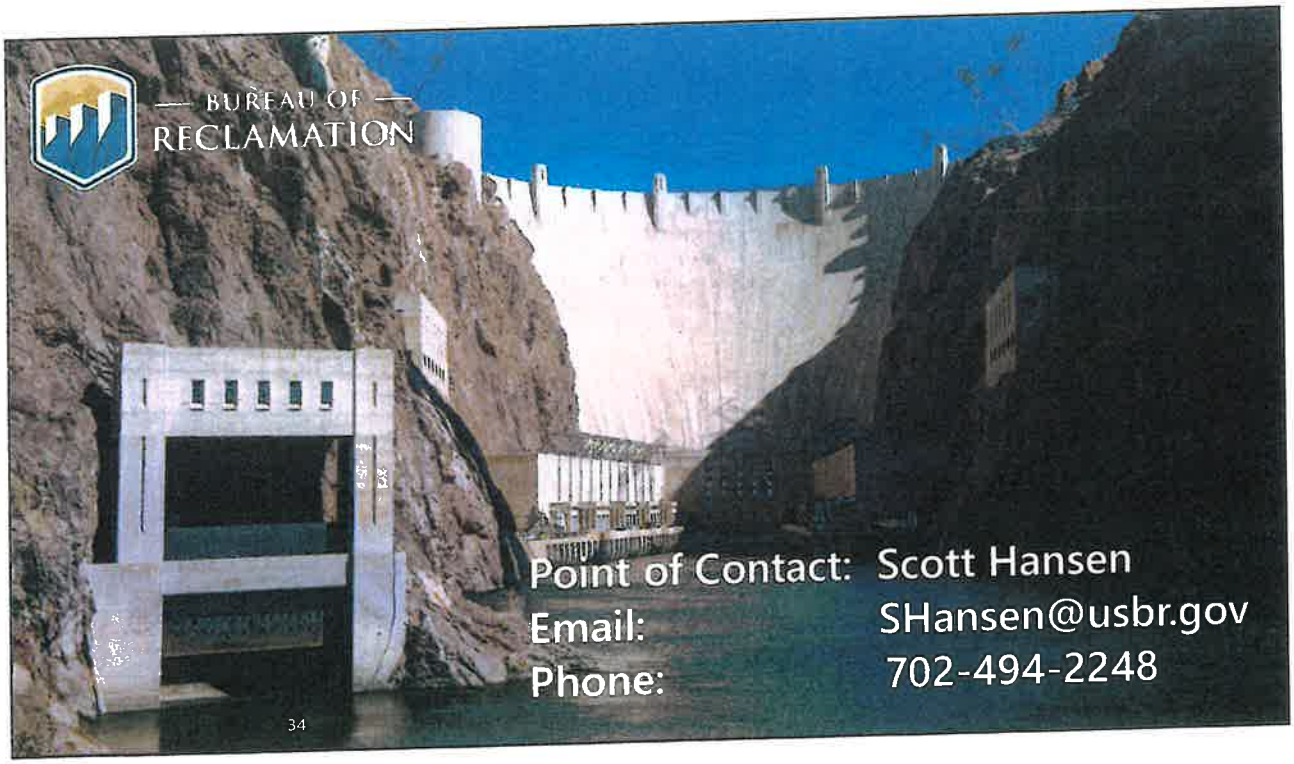

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Wide Head Turbine Economics and Way Forward

Matthew Stemmer

Jan 21, 2025

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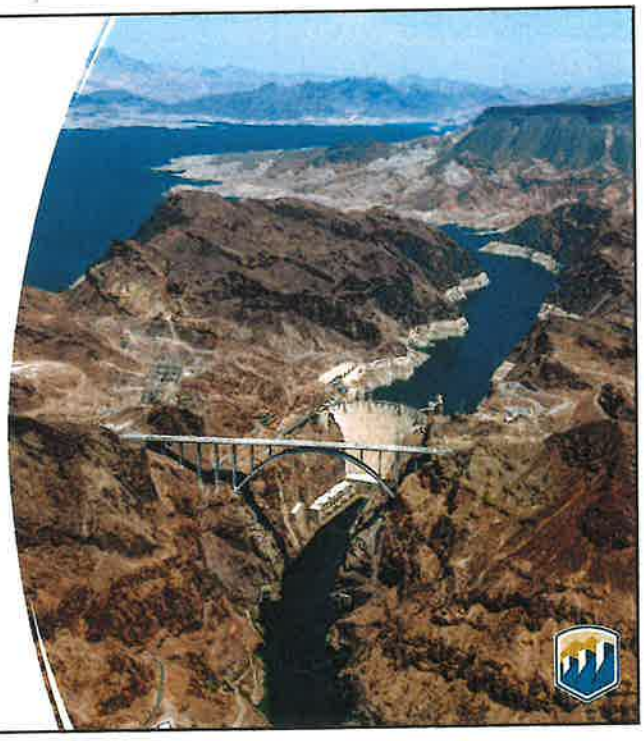
Presentation is an initial estimate for the cost and value of purchasing new wide head turbines with many assumptions and is just a start for discussion. Additional analysis will need to be done before Reclamation can make a formal recommendation

Presentation flow:

- Assumptions
- Timeline and Considerations
- Financing Timeline and Cost
- Economic Analysis
- Return on Investment
- Recommendations and Discussion



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Assumptions

- Hoover Dam Cost - Based on Hoover Dam Ten Year Operating Plan, estimates of annual cost for Multi-Species Conservation Program, and energy surcharge costs
  - Hoover Dam TYOP costs likely will change - particularly out year may be able to defer (drum gate rehab) and/or need to finance larger projects such as rewinds.
- If purchase just one turbine, then would not finance
- Analysis is based on ONE energy projection in elevation range below elevation 1035.
- Uses FY 2024 energy values from CAISO SP-15 Node
  - Energy value adjusted 2%/yrs based on US Energy Information Administration
- First Turbine installation will take 4 years (3 years design and manufacturing, 1 year installation) and value captured in 5th year.

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Timeline and Considerations

- Timeline
  - Expect completion of technical specification package this summer (2026)
  - If funded this summer, then at best first turbine installed in 2030, online in 2031
  - Plan on formatting technical specification to be able to award more than one turbine, so if funding is available, will be able to purchase additional turbines and install a new turbines annually thereafter
- Considerations looking forward
  - Hydrology
  - Funding Sources (still a possibility)
    - Non-Reimbursable Infrastructure and Investment Jobs Act (IIJA) and
    - Post Retirement Benefit Funds
  - When do we commit to purchasing new turbine?
  - Current Turbine Challenges (A8 and A9)
    - A8 damage
    - A9 condition and possibility of DOE contract?
  - Minimum number of turbines needed?
  - Financing?

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Financing

- Process
  - Appropriations Process
    - 2-year process, so funds would not be available until 2028
  - Apply for Reimbursable Inflation Reduction Act (IRA) funds
    - If approved, could take as little as 3 months to receive the funds
- Cost
  - Approximately $750k/year for each turbine
    - Assumed 30-year repayment
    - Assumed 4% interest rate
- Impact to Ten Year Plan
  - Add $2.2M/yr for 3 turbines
  - Like always will look for ways to minimize budget increase but initial look is no easy deferrable projects in current TYOP until 2032 (for example Drum Gate Overhauls)

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Estimated Hoover Dam Cost vs Value - One Hydrology Trace most months below elevation 1,035 ft

	2027	2028	2029	2030	2031	2032	2033	2034
Hoover Dam Cost	90,809,355	95,434,733	99,748,355	106,947,064	113,616,746	120,578,790	126,488,202	139,948,971
Hoover Dam Value (elevation ~1035 - 5 wide head turbines)	94,367,886	96,255,244	98,180,349	100,143,956	102,146,835	104,189,771	106,273,567	108,399,038
Cost vs. Value (no additional turbines)	**3,558,531**	**820,511**	**(1,568,007)**	**(6,803,109)**	**(11,469,911)**	**(16,389,019)**	**(20,214,635)**	**(31,549,933)**
1 Additional Turbine					**1st turbine**			
Hoover Dam Value (elevation ~1035 - 6 wide head turbines)	94,367,886	96,255,244	98,180,349	100,143,956	112,238,511	114,483,281	116,772,947	119,108,406
Total Cost with Turbine	95,809,355	100,434,733	102,748,355	106,947,064	113,616,746	120,578,790	126,488,202	139,948,971
Cost vs Value (1 additional turbine)	**(1,441,469)**	**(4,179,489)**	**(4,568,007)**	**(6,803,109)**	**(1,378,235)**	**(6,095,509)**	**(9,715,255)**	**(20,840,565)**
3 Additional Turbines					**1st turbine**	**2nd turbine**	**3rd turbine**	
Hoover Dam Value (elevation ~1035 - 8 wide head turbines)	94,367,886	96,255,244	98,180,349	100,143,956	112,238,511	122,769,588	133,105,877	135,767,995
Total Cost with Turbine	93,064,655	97,690,033	102,003,655	109,202,364	115,872,046	122,834,090	128,743,502	142,204,271
Cost vs Value (3 additional turbines)	**1,303,231**	**(1,434,789)**	**(3,823,307)**	**(9,058,409)**	**(3,633,535)**	**(64,502)**	**4,362,376**	**(6,436,276)**
5 Additional Turbines					**1st turbine**	**2nd turbine**	**3rd turbine**	**4th turbine**
Hoover Dam Value (elevation ~1035 - 10 wide head turbines)	94,367,886	96,255,244	98,180,349	100,143,956	112,238,511	122,769,588	133,105,877	142,832,828
Total Cost with Turbines	94,568,255	99,193,633	103,507,255	110,705,964	117,375,646	124,337,690	130,247,102	143,707,871
Cost vs Value (5 additional turbines)	**(200,369)**	**(2,938,389)**	**(5,326,907)**	**(10,562,009)**	**(5,137,135)**	**(1,568,102)**	**2,858,776**	**(875,043)**

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Estimated Return on Investment

Estimated return on Investment if Lake Mead elevation below 1,035 ft

Below Elevation 1,035 estimated Return on Investment

Number of Additional Turbines	Cost	Annual Value Gain	Simple ROI (years)
1	$13,000,000	$9,323,149	**1.4**
2	$13,000,000	$7,505,163	**1.7**
3	$13,000,000	$6,998,012	**1.8**
4	$13,000,000	$6,150,362	**2.1**
5	$13,000,000	$4,888,405	**2.6**
6	$13,000,000	$2,660,623	**4.8**

Estimated return on Investment current Lake elevation

Estimated Return on Investment/Turbine if lake elevation above 1035

Unit	Capacity Gain	Value of Capacity $/MW	Hours	Days	Annual Value	Cost (ea)	Simple ROI (years)
A3	14	$5	24	365	$613,200	$13,000,000	**21.20**
A4	15	$5	24	365	$657,000	$13,000,000	**19.79**
A5	8	$5	24	365	$350,400	$13,000,000	**37.10**
N2	6	$5	24	365	$262,800	$13,000,000	**49.47**
A6	3	$5	24	365	$131,400	$13,000,000	**98.93**
A7	4	$5	24	365	$175,200	$13,000,000	**74.20**
Other Additional Turbine	1	$5	24	365	$43,800	$13,000,000	**296.80**

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Recommendation and Discussion

- Finish development of technical specification
- Continue to "push" for non-BCP source of funds
- Determine way ahead with A8 and A9
- Watch Hydrology
- Reclamation to continue to work on estimates
- Develop alternatives for funding if necessary
- Provide update at May E&OC or earlier if things change

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