Design Review Committee Briefing #14

Subject: Aeration Blowers Approach Recommendation

Date: January 11, 2019

The Issue

The proposed Phase II Upgrades of the Nampa WWTP require additional aeration air to provide the necessary oxygen to the biological process. The Nampa WWTP currently has five multistage centrifugal (MSC) blowers used for providing air to the existing aeration basins with one of those blowers serving as a redundant unit. They are each rated for 6,250 standard cubic feet per minute (SCFM). The theoretical capacity of four blowers in operation simultaneously is approximately 25,000 SCFM.

Background and Analysis

Table 1 summarizes the existing blower capacities and future peak aeration demand, which is used for the sizing and evaluation of the blower expansion alternatives.

Table 1. Blower Design Criteria

Operating Regime	Influent
Existing theoretical blower capacity, SCFM [1]	25,000
Existing aeration demand, SCFM [2]	5,000 to 12,000
2040 annual average air demand, SCFM	24,375
2040 peak air demand, SCFM	48,750
'Build-out' peak air demand, SCFM	~61,000

[1] Theoretical capacity of existing blowers assumed to equal 6,250 SCFM x 4 duty blowers.

[2] Plant staff indicate existing blowers are typically limited to a capacity of ~12,000 SCFM with two blowers in operation due to surge concerns, pipe rupture, and diffuser blow-out risk. Higher flows may be achievable.

The alternatives considered as part of this evaluation are described in the following list, and process flow diagrams for each configuration are provided in Figures 1 through 5.

Alternative 1—Existing Blower Building: Alternative 1 is based on retaining the existing blower building and replacing the undersized blowers with new blowers sized to accommodate future demand. The proposed blower configuration consists of six 700-hp units each rated at 9,750 SCFM. Only four of the six proposed blowers would fit within the existing footprint of the blower room. Since the proposed blowers are unable to fit within the existing blower room, it was determined that Alternative 1 is not able to meet future design flows and is therefore a fatally flawed alternative.

Alternative 2—Existing Blower Building & BFP Room Expansion: Alternative 2 is based on retaining the five existing blowers to provide a portion of the future aeration demand and repurposing the soon-to-be abandoned Belt Filter Press (BFP) Room to accommodate the installation of two new blowers to supplement the existing blower capacity. The proposed blowers in the BFP room consist of two 800-hp units each rated at 12,000 SCFM. The size of these blowers would require extensive modifications to the existing structure, which the Preliminary Design Technical Team concluded were not feasible. Therefore, this alternative is considered fatally flawed.

Alternative 3—Existing Blower Building and New Blower Building: Alternative 3 is based on retaining the five existing blowers to provide a portion of the demand and constructing a new blower building for the installation of three new blowers to supplement the existing blower capacity. The proposed blowers in the new

blower building consist of three 600-hp units each rated at 8,000 SCFM. The new blower building associated with Alternative 3 is approximately 6,200 square feet ($ft^{2)}$ and would be located at the northeast end of the plant adjacent to the proposed Aeration Basin No. 4. The reliance on aging infrastructure, risk of existing blower failure, and complexity of running multiple blower systems resulted in the Preliminary Design Technical Team concluding Alternative 3 not being viable for further evaluation.

Alternative 4—New Blower Building: Alternative 4 is based on abandoning the existing blowers and building and constructing a new blower building for the installation of six new blowers to meet the entire aeration demand. The proposed blowers in the new blower building consist of six 700-hp units each rated at 9,750 SCFM. Space in the new building would be allocated for two future blowers to meet buildout air demand. The new blower building associated with Alternative 4 is approximately 8,600 ft^2 and would be located at the northeast end of the plant adjacent to the proposed Aeration Basin No. 4. Alternative 4 presents a more reliable and less complex approach to providing aeration capacity for the secondary treatment process and is therefore recommended for further evaluation.

Alternative 5—New Blower Building (Phased Blower Installation): Alternative 5 is based on retaining the five existing blowers to provide a portion of the near-term demand and constructing a new blower building for the phased installation of six new blowers to supplement the existing blower capacity. The proposed blowers in the new blower building consist of six 700-hp units each rated at 9,750 SCFM. The existing blowers will be phased out as they become non-operational or are unable to meet increasing demand. Similar to Alternative 4, the new blower building associated with Alternative 5 is approximately 8,600 ft^2 and would be located at the northeast end of the plant adjacent to the proposed Aeration Basin No. 4. Alternative 5 presents a feasible approach to providing aeration capacity for the secondary treatment process and is therefore recommended for further evaluation.

Capital costs, operating and maintenance (O&M) costs, and repair and replacement (R&R) costs were estimated for Alternatives 4 and 5. Life cycle costs were used to determine the net present value (NPV) for each alternative.

The incremental cost associated with phased blower installations for Alternative 5 results in a higher NPV given the cost for present-day construction is generally less expensive than for future construction. The operating costs associated with Alternative 5 considers additional staffing needed to operate two separate blower systems. Alternative 5 takes into account the repair and replacement of infrastructure for both the existing blower building and the new system together, resulting in higher operating costs.

Table 2 presents the results of the blower expansion BCE. The BCE results indicated Alternative 4 has the lowest cost of asset ownership driven by lower capital and operating costs as compared to Alternative 5.

Table 2. BCE Total Net Present Value Summary[1,2]

Alternative	Capital	O&M	Risks	R&R	NPV
Alternative 4: New Blower Building	$12,516,000	$6,523,000	$0	$6,838,000	($27,926,000)
Alternative 5: New Blower Building (Phased Implementation)	$12,666,000	$7,148,000	$32,000	$10,268,000	($32,964,000)

[1]Cells highlighted in green indicate the lowest cost alternative for the conditions shown.

[2]Total costs are shown in 2018 dollars, represent the period 2021 through 2040, and are rounded to the nearest $1,000.

NPV = net present value.

Potential Consequences

The Design Review Committee should be aware of the potential consequences of each alternative that may not be readily apparent from the BCE results. The primary consequences from this evaluation are described in further detail below:

- **Near-Term Capital Costs:** While the overall capital costs for Alternatives 4 and 5 are similar, the timing of the expenditures varies between the two alternatives. The capital costs for Alternative 4, $12.5M in 2018 dollars, would all be incurred between now and 2025. However, in Alternative 5, only $9.2M (2018 dollars) would be spent in this same time. The additional capital for Alternative 5, $3.5M (2018 dollars), would be invested between 2026 and 2040.
- **Just-in-Time Asset Replacement:** The Alternative 5 approach for blower expansion uses the remaining life of the existing blowers for a portion of the near-term demand but ultimately relies on all new blowers to meet future capacity. This approach supports a just-in-time asset replacement approach, which is why capital costs are delayed until after 2025. However, this approach does increase the risks associated with Alternative 5 as compared to Alternative 4 due to reliance on aged infrastructure in the near-term and complications due to operating two blower systems. This option requires operating and controlling two blower systems before the existing units are completely abandoned, so is more complex than Alternative 4 from that regard.

Recommendation

The Preliminary Design Technical Team recommends moving forward with Alternative 4—New Blower Building. This recommendation is consistent with the results of the BCE process as presented in Table 2. Alternative 4 represents the lowest capital and operating cost due to having a single blower system, whereas Alternative 5 results in higher operating and maintenance costs due to having two separate blower systems in operation.

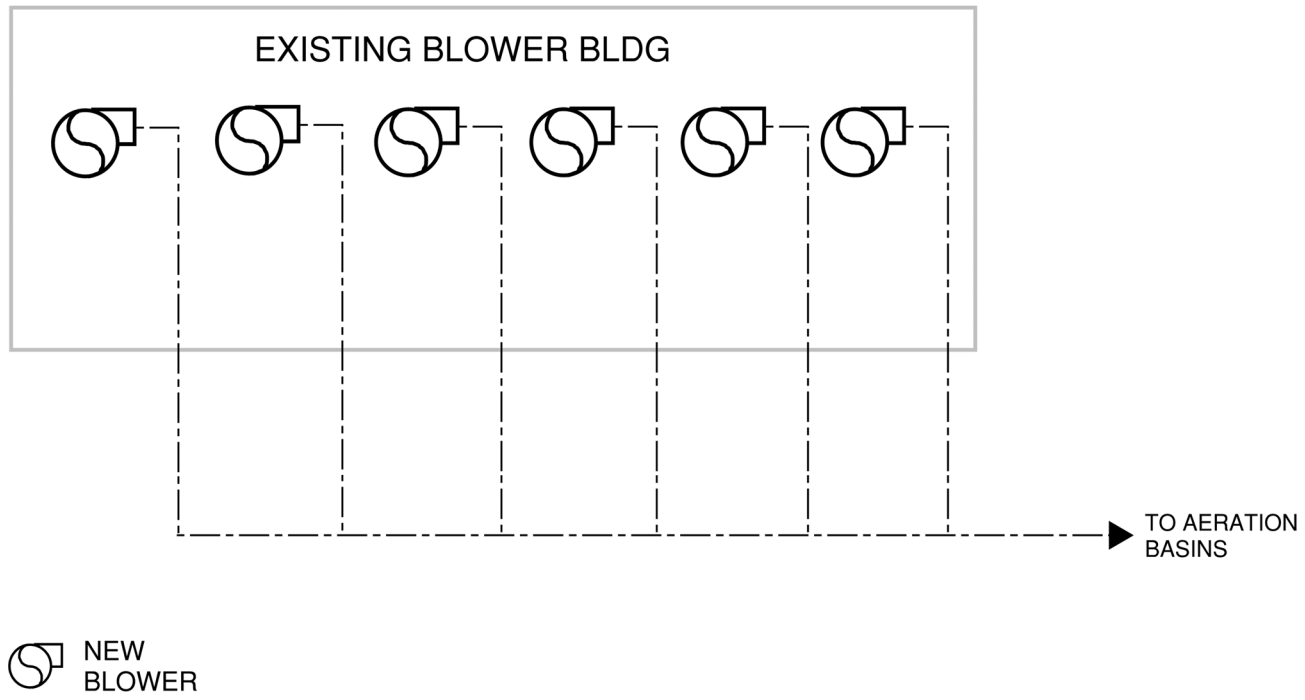

Figure 1. Process flow diagram—Alternative 1

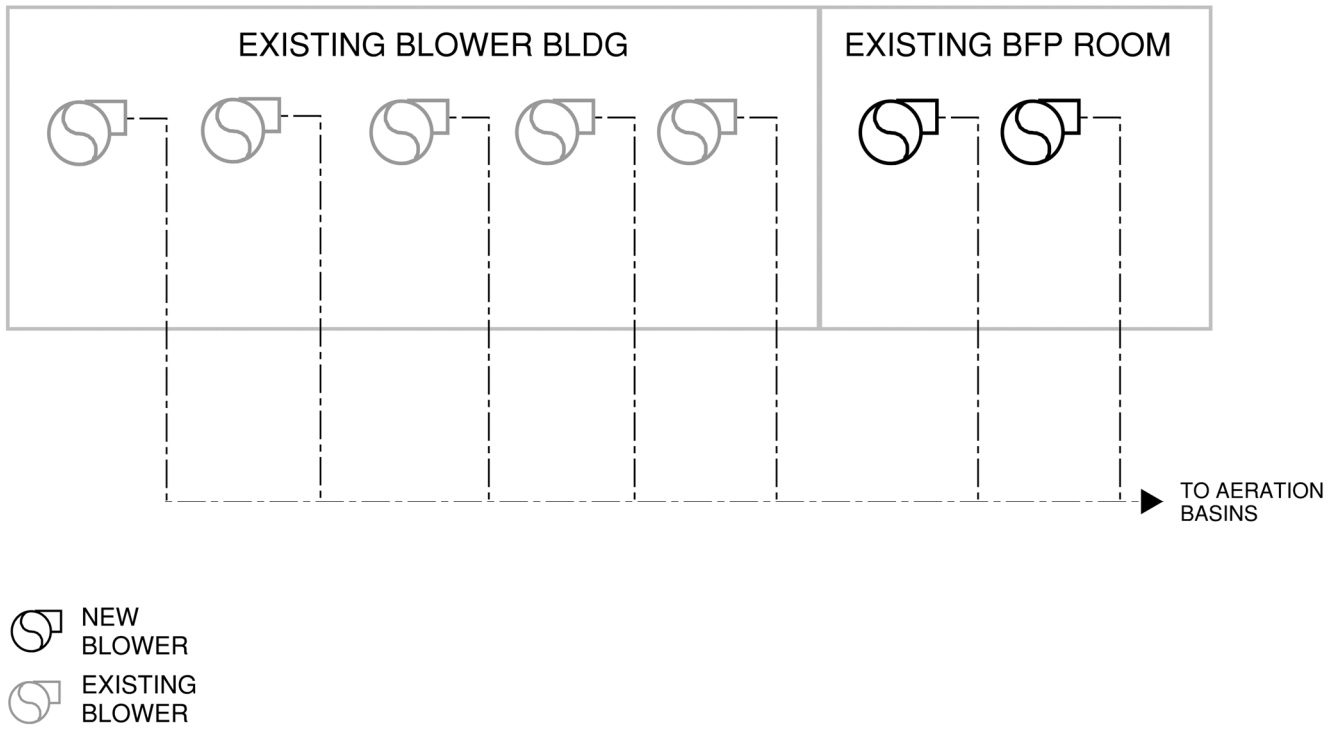

Figure 2. Process flow diagram—Alternative 2

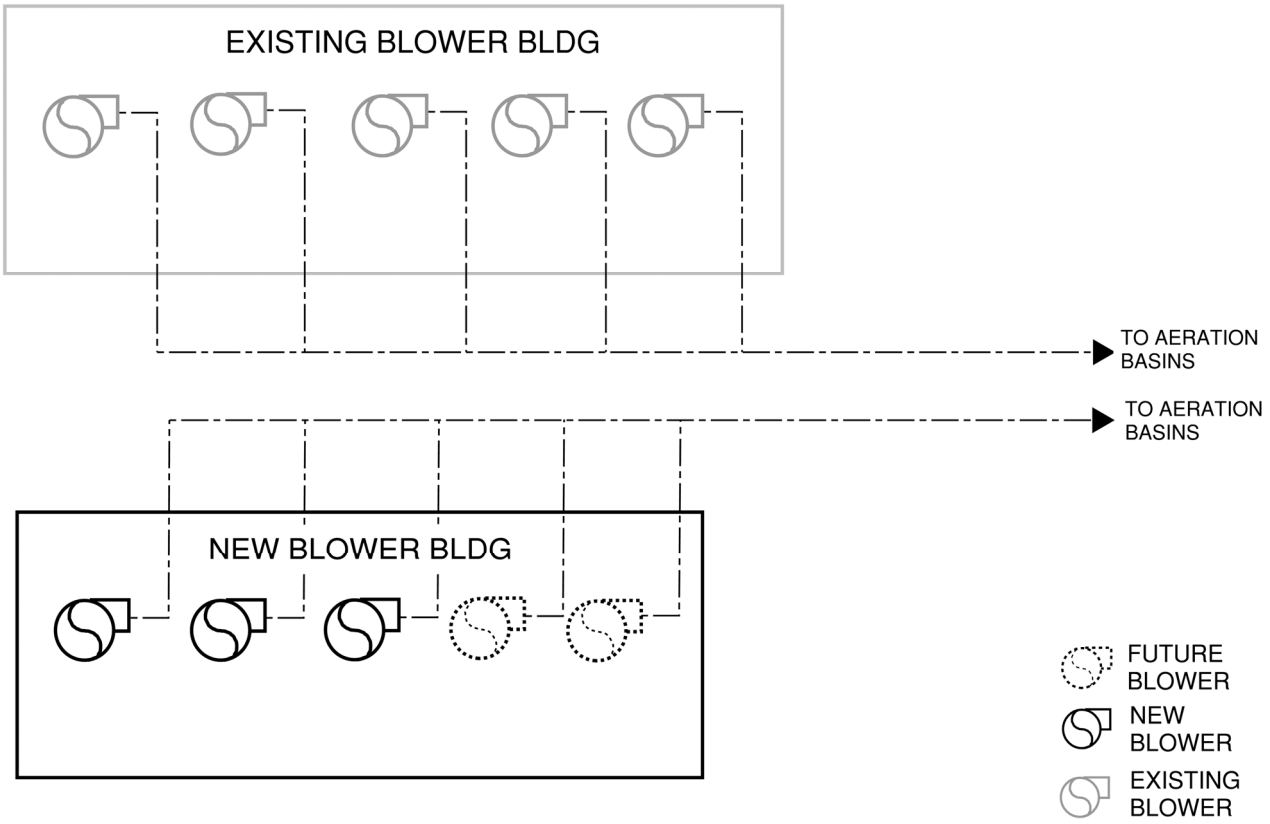

Figure 3. Process flow diagram—Alternative 3

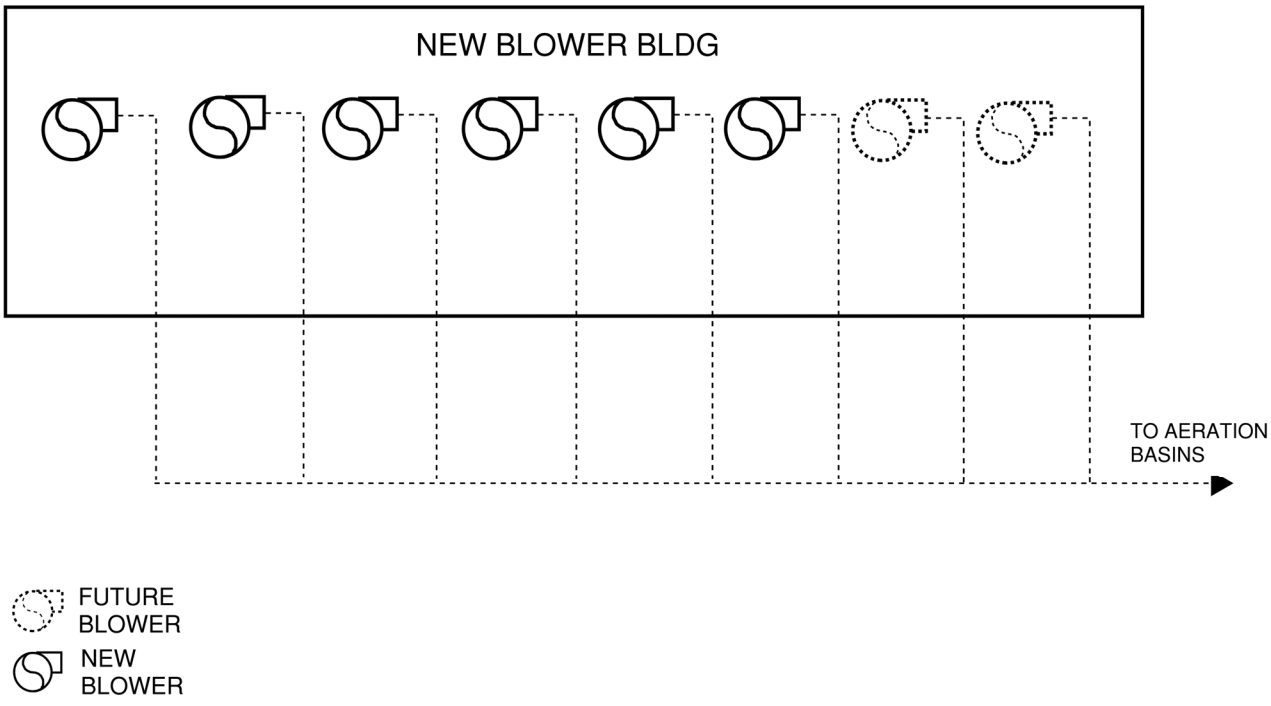

Figure 4. Process flow diagram—Alternative 4

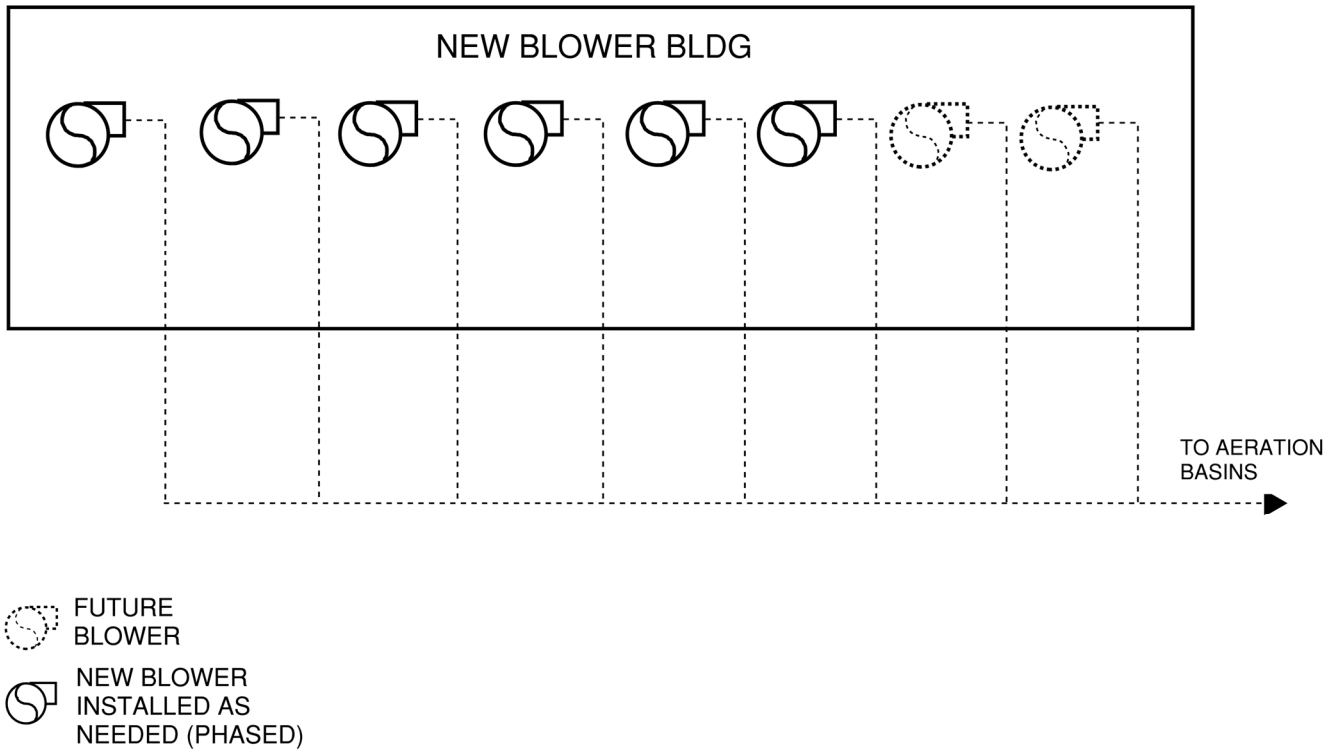

Figure 5. Process flow diagram—Alternative 5