City of Ketchum

CITY COUNCIL MEETING AGENDA MEMO

Meeting Date:	May 1, 2023	Staff Member/Dept:	Mick Mummert/Utilities

Agenda Item:	Recommendation to Approve a Master Services Agreement with HDR Engineering and Task Order #01 to the agreement.

Recommended Motion:

I move to approve Agreement #22851 with the HDR Engineering, Inc for a Master Services Agreement for Professional Services and Purchase Order #23090 for Task Order #01 to the agreement for a not to exceed amount of $250,340.00.

Reasons for Recommendation:

- The Utilities Department uses an engineering firm to perform "on-call" engineering services for capital improvements at the wastewater treatment facility.
- HDR Engineering, Inc currently has a Master Services Agreement with the City of Ketchum and Sun Valley Water and Sewer District for work at the treatment facility.
- The new agreement will account for changes in HDR's Terms and Conditions which have been made since the previous agreement was entered into.
- Task Order #01 is for the detailed design of the activated sludge aeration system upgrades portion of the Capital Improvement Projects at the wastewater treatment plant.

Policy Analysis and Background (non-consent items only):

Sustainability Impact:

None OR state impact here: The new equipment and process will reduce energy consumption at the treatment plant, helping Ketchum realize its sustainability goals.

Financial Impact:

None OR Adequate funds exist in account:	Adequate funds for this design package are in the FY23 Wastewater CIP budget. Estimated construction cost for the project is $3.788M. This is a capital improvement expense which will be shared equally with the Sun Valley Water and Sewer District.

Attachments:

1.	HDR Master Services Agreement
2.	Purchase Order #23090
3.	HDR Task Order #01
4.	AB Blower Tech Memo
5.	MLE Tech Memo

MASTER SHORT FORM AGREEMENT FOR PROFESSIONAL SERVICES

THIS AGREEMENT is made as of this ______ day of April, 2023, between _City of Ketchum and Sun Valley Water & Sewer District (SVWSD), hereinafter referred to as "OWNER", and HDR Engineering, Inc., hereinafter referred to as "ENGINEER" or "CONSULTANT," for engineering services as described in this Agreement.

WHEREAS, OWNER desires to retain ENGINEER, a professional engineering firm, to provide professional engineering, consulting and related services ("Services") on one or more projects in which the OWNER is involved; and

WHEREAS, ENGINEER desires to provide such services on such projects as may be agreed, from time to time, by the parties;

NOW, THEREFORE, in consideration of the mutual covenants contained herein, the parties agree as follows:

SECTION I. PROJECT TASK ORDER

1.1 This Agreement shall apply to as many projects as OWNER and ENGINEER agree will be performed under the terms and conditions of this Agreement. Each project ENGINEER performs for OWNER hereunder shall be designated by a "Task Order." A sample Task Order is attached to this Agreement and marked as Exhibit "A". No Task Order shall be binding or enforceable unless and until it has been properly executed by both OWNER and ENGINEER. Each properly executed Task Order shall become a separate supplemental agreement to this Agreement.

1.2 In resolving potential conflicts between this Agreement and the Task Order pertaining to a specific project, the terms of this Agreement shall control.

1.3 ENGINEER will provide the Scope of Services as set forth in Part 2 of each Task Order.

SECTION II. RESPONSIBILITIES OF OWNER

In addition to the responsibilities described in paragraph 6 of the attached "HDR Engineering, Inc. Terms and Conditions for Professional Services," OWNER shall have the responsibilities described in Part 3 of each Task Order.

SECTION III. COMPENSATION

Compensation for ENGINEER's Services shall be in accordance with Part 5 of each Task Order, and in accordance with paragraph 11 of the attached HDR Engineering, Inc. Terms and Conditions.

SECTION IV. TERMS AND CONDITIONS OF ENGINEERING SERVICES

The HDR Engineering, Inc. Terms and Conditions, which are attached hereto in Exhibit B, are incorporated into this Agreement by this reference as if fully set forth herein.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first written above.

City of Ketchum "OWNER"		Sun Valley Water & Sewer District (SVWSD) "OWNER"	
BY:	__________	BY:	[signature]
NAME:	__________	NAME:	James Loyd
TITLE:	__________	TITLE:	Chairman
ADDRESS	__________	ADDRESS:	__________

HDR ENGINEERING, INC.
"ENGINEER"

BY: __________

NAME: Kate Eldridge

TITLE: Sr Vice President

ADDRESS: 412 E Parkcenter Blvd., Suite 100
Boise, Idaho 83706

EXHIBIT A

<u>TASK ORDER</u>

This Task Order pertains to an Agreement by and between ________________________, ("OWNER"), and HDR Engineering, Inc. ("ENGINEER"), dated ________________, 20___, ("the Agreement"). Engineer shall perform services on the project described below as provided herein and in the Agreement. This Task Order shall not be binding until it has been properly signed by both parties. Upon execution, this Task Order shall supplement the Agreement as it pertains to the project described below.

TASK ORDER NUMBER:
PROJECT NAME:

PART 1.0 PROJECT DESCRIPTION:

PART 2.0 SCOPE OF SERVICES TO BE PERFORMED BY ENGINEER ON THE PROJECT:

PART 3.0 OWNER'S RESPONSIBILITIES:

PART 4.0 PERIODS OF SERVICE:

PART 5.0 ENGINEER'S FEE:

PART 6.0 OTHER:

This Task Order is executed this __________ day of ________________, 20___.

______________________ "OWNER"		HDR ENGINEERING, INC. "ENGINEER"	
BY:	______________________	BY:	______________________
NAME:	______________________	NAME:	______________________
TITLE:	______________________	TITLE:	______________________
ADDRESS:	______________________	ADDRESS:	______________________
	______________________		______________________

EXHIBIT B

TERMS AND CONDITIONS

HDR Engineering, Inc. Terms and Conditions for Professional Services

1. **STANDARD OF PERFORMANCE**
The standard of care for all professional engineering, consulting and related services performed or furnished by ENGINEER and its employees under this Agreement will be the care and skill ordinarily used by members of ENGINEER's profession practicing under the same or similar circumstances at the same time and in the same locality. ENGINEER makes no warranties, express or implied, under this Agreement or otherwise, in connection with ENGINEER's services.

2. **INSURANCE/INDEMNITY**
ENGINEER agrees to procure and maintain, at its expense, Workers' Compensation insurance as required by statute; Employer's Liability of $250,000; Automobile Liability insurance of $1,000,000 combined single limit for bodily injury and property damage covering all vehicles, including hired vehicles, owned and non-owned vehicles; Commercial General Liability insurance of $1,000,000 combined single limit for personal injury and property damage; and Professional Liability insurance of $1,000,000 per claim for protection against claims arising out of the performance of services under this Agreement caused by negligent acts, errors, or omissions for which ENGINEER is legally liable. If flying an Unmanned Aerial System (UAS or drone), ENGINEER will procure and maintain aircraft unmanned aerial systems insurance of $1,000,000 per occurrence. OWNER shall be made an additional insured on Commercial General and Automobile Liability insurance policies and certificates of insurance will be furnished to the OWNER. ENGINEER agrees to indemnify OWNER for third party personal injury and property damage claims to the extent caused by ENGINEER's negligent acts, errors or omissions. However, neither Party to this Agreement shall be liable to the other Party for any special, incidental, indirect, or consequential damages (including but not limited to loss of use or opportunity; loss of good will; cost of substitute facilities, goods, or services; cost of capital; and/or fines or penalties), loss of profits or revenue arising out of, resulting from, or in any way related to the Project or the Agreement from any cause or causes, including but not limited to any such damages caused by the negligence, errors or omissions, strict liability or breach of contract. The employees of both parties are intended third party beneficiaries of this waiver of consequential damages.

3. **OPINIONS OF PROBABLE COST (COST ESTIMATES)**
Any opinions of probable project cost or probable construction cost provided by ENGINEER are made on the basis of information available to ENGINEER and on the basis of ENGINEER's experience and qualifications, and represents its judgment as an experienced and qualified professional engineer. However, since ENGINEER has no control over the cost of labor, materials, equipment or services furnished by others, or over the contractor(s') methods of determining prices, or over competitive bidding or market conditions, ENGINEER does not guarantee that proposals, bids or actual project or construction cost will not vary from opinions of probable cost ENGINEER prepares.

4. **CONSTRUCTION PROCEDURES**
ENGINEER's observation or monitoring portions of the work performed under construction contracts shall not relieve the contractor from its responsibility for performing work in accordance with applicable contract documents. ENGINEER shall not control or have charge of, and shall not be responsible for, construction means, methods, techniques, sequences, procedures of construction, health or safety programs or precautions connected with the work and shall not manage, supervise, control or have charge of construction. ENGINEER shall not be responsible for the acts or omissions of the contractor or other parties on the project. ENGINEER shall be entitled to review all construction contract documents and to require that no provisions extend the duties or liabilities of ENGINEER beyond those set forth in this Agreement. OWNER agrees to include ENGINEER as an indemnified party in OWNER's construction contracts for the work, which shall protect ENGINEER to the same degree as OWNER. Further, OWNER agrees that ENGINEER shall be listed as an additional insured under the construction contractor's liability insurance policies.

5. **CONTROLLING LAW**
This Agreement is to be governed by the law of the state where ENGINEER's services are performed.

6. **SERVICES AND INFORMATION**
OWNER will provide all criteria and information pertaining to OWNER's requirements for the project, including design objectives and constraints, space, capacity and performance requirements, flexibility and expandability, and any budgetary limitations. OWNER will also provide copies of any OWNER-furnished Standard Details, Standard Specifications, or Standard Bidding Documents which are to be incorporated into the project.

OWNER will furnish the services of soils/geotechnical engineers or other consultants that include reports and appropriate professional recommendations when such services are deemed necessary by ENGINEER. The OWNER agrees to bear full responsibility for the technical accuracy and content of OWNER-furnished documents and services.

In performing professional engineering and related services hereunder, it is understood by OWNER that ENGINEER is not engaged in rendering any type of legal, insurance or accounting services, opinions or advice. Further, it is the OWNER's sole responsibility to obtain the advice of an attorney, insurance counselor or accountant to protect the OWNER's legal and financial interests. To that end, the OWNER agrees that OWNER or the OWNER's representative will examine all studies, reports, sketches, drawings, specifications, proposals and other documents, opinions or advice prepared or provided by ENGINEER, and will obtain the advice of an attorney, insurance counselor or other consultant as the OWNER deems necessary to protect the OWNER's interests before OWNER takes action or forebears to take action based upon or relying upon the services provided by ENGINEER.

7. **SUCCESSORS, ASSIGNS AND BENEFICIARIES**
OWNER and ENGINEER, respectively, bind themselves, their partners, successors, assigns, and legal representatives to the covenants of this Agreement. Neither OWNER nor ENGINEER will assign, sublet, or transfer any interest in this Agreement or claims arising therefrom without the written consent of the other. No third party beneficiaries are intended under this Agreement.

8. **RE-USE OF DOCUMENTS**
All documents, including all reports, drawings, specifications, computer software or other items prepared or furnished by ENGINEER pursuant to this Agreement, are instruments of service with respect to the project. ENGINEER retains ownership of all such documents. OWNER may retain copies of the documents for its information and reference in connection with the project; however, none of the documents are intended or represented to be suitable for reuse by OWNER or others on extensions of the project or on any other project. Any reuse without written verification or adaptation by ENGINEER for the specific purpose intended will be at OWNER's sole risk and without liability or legal exposure to ENGINEER, and OWNER will defend, indemnify and hold harmless ENGINEER from all claims, damages, losses and expenses, including attorney's fees,

arising or resulting therefrom. Any such verification or adaptation will entitle ENGINEER to further compensation at rates to be agreed upon by OWNER and ENGINEER.

9. TERMINATION OF AGREEMENT
OWNER or ENGINEER may terminate the Agreement, in whole or in part, by giving seven (7) days written notice to the other party. Where the method of payment is "lump sum," or cost reimbursement, the final invoice will include all services and expenses associated with the project up to the effective date of termination. An equitable adjustment shall also be made to provide for termination settlement costs ENGINEER incurs as a result of commitments that had become firm before termination, and for a reasonable profit for services performed.

10. SEVERABILITY
If any provision of this agreement is held invalid or unenforceable, the remaining provisions shall be valid and binding upon the parties. One or more waivers by either party of any provision, term or condition shall not be construed by the other party as a waiver of any subsequent breach of the same provision, term or condition.

11. INVOICES
ENGINEER will submit monthly invoices for services rendered and OWNER will make payments to ENGINEER within thirty (30) days of OWNER's receipt of ENGINEER's invoice.

ENGINEER will retain receipts for reimbursable expenses in general accordance with Internal Revenue Service rules pertaining to the support of expenditures for income tax purposes. Receipts will be available for inspection by OWNER's auditors upon request.

If OWNER disputes any items in ENGINEER's invoice for any reason, including the lack of supporting documentation, OWNER may temporarily delete the disputed item and pay the remaining amount of the invoice. OWNER will promptly notify ENGINEER of the dispute and request clarification and/or correction. After any dispute has been settled, ENGINEER will include the disputed item on a subsequent, regularly scheduled invoice, or on a special invoice for the disputed item only.

OWNER recognizes that late payment of invoices results in extra expenses for ENGINEER. ENGINEER retains the right to assess OWNER interest at the rate of one percent (1%) per month, but not to exceed the maximum rate allowed by law, on invoices which are not paid within thirty (30) days from the date OWNER receives ENGINEER's invoice. In the event undisputed portions of ENGINEER's invoices are not paid when due, ENGINEER also reserves the right, after seven (7) days prior written notice, to suspend the performance of its services under this Agreement until all past due amounts have been paid in full.

12. CHANGES
The parties agree that no change or modification to this Agreement, or any attachments hereto, shall have any force or effect unless the change is reduced to writing, dated, and made part of this Agreement. The execution of the change shall be authorized and signed in the same manner as this Agreement. Adjustments in the period of services and in compensation shall be in accordance with applicable paragraphs and sections of this Agreement. Any proposed fees by ENGINEER are estimates to perform the services required to complete the project as ENGINEER understands it to be defined. For those projects involving conceptual or process development services, activities often are not fully definable in the initial planning. In any event, as the project progresses, the facts developed may dictate a change in the services to be performed, which may alter the scope. ENGINEER will inform OWNER of such situations so that changes in scope and adjustments to the time of performance and compensation can be made as required. If such change, additional services, or suspension of services results in an increase or decrease in the cost of or time required for performance of the services, an equitable adjustment shall be made, and the Agreement modified accordingly.

13. CONTROLLING AGREEMENT
These Terms and Conditions shall take precedence over any inconsistent or contradictory provisions contained in any proposal, contract, purchase order, requisition, notice-to-proceed, or like document.

14. EQUAL EMPLOYMENT AND NONDISCRIMINATION
In connection with the services under this Agreement, ENGINEER agrees to comply with the applicable provisions of federal and state Equal Employment Opportunity for individuals based on color, religion, sex, or national origin, or disabled veteran, recently separated veteran, other protected veteran and armed forces service medal veteran status, disabilities under provisions of executive order 11246, and other employment, statutes and regulations, as stated in Title 41 Part 60 of the Code of Federal Regulations § 60-1.4 (a-f), § 60-300.5 (a-e), § 60-741 (a-e).

15. HAZARDOUS MATERIALS
OWNER represents to ENGINEER that, to the best of its knowledge, no hazardous materials are present at the project site. However, in the event hazardous materials are known to be present, OWNER represents that to the best of its knowledge it has disclosed to ENGINEER the existence of all such hazardous materials, including but not limited to asbestos, PCB's, petroleum, hazardous waste, or radioactive material located at or near the project site, including type, quantity and location of such hazardous materials. It is acknowledged by both parties that ENGINEER's scope of services do not include services related in any way to hazardous materials. In the event ENGINEER or any other party encounters undisclosed hazardous materials, ENGINEER shall have the obligation to notify OWNER and, to the extent required by law or regulation, the appropriate governmental officials, and ENGINEER may, at its option and without liability for delay, consequential or any other damages to OWNER, suspend performance of services on that portion of the project affected by hazardous materials until OWNER: (i) retains appropriate specialist consultant(s) or contractor(s) to identify and, as appropriate, abate, remediate, or remove the hazardous materials; and (ii) warrants that the project site is in full compliance with all applicable laws and regulations. OWNER acknowledges that ENGINEER is performing professional services for OWNER and that ENGINEER is not and shall not be required to become an "arranger," "operator," "generator," or "transporter" of hazardous materials, as defined in the Comprehensive Environmental Response, Compensation, and Liability Act of 1990 (CERCLA), which are or may be encountered at or near the project site in connection with ENGINEER's services under this Agreement. If ENGINEER's services hereunder cannot be performed because of the existence of hazardous materials, ENGINEER shall be entitled to terminate this Agreement for cause on 30 days written notice. To the fullest extent permitted by law, OWNER shall indemnify and hold harmless ENGINEER, its officers, directors, partners, employees, and subconsultants from and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) caused by, arising out of or resulting from hazardous materials, provided that (i) any such cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or injury to or destruction of tangible property (other than completed Work), including the loss of use resulting therefrom, and (ii) nothing in this paragraph shall obligate OWNER to indemnify any individual or entity from and against the consequences of that individual's or entity's sole negligence or willful misconduct.

16. EXECUTION
This Agreement, including the exhibits and schedules made part hereof, constitute the entire Agreement between ENGINEER and

OWNER, supersedes and controls over all prior written or oral understandings. This Agreement may be amended, supplemented or modified only by a written instrument duly executed by the parties.

17. ALLOCATION OF RISK
OWNER AND ENGINEER HAVE EVALUATED THE RISKS AND REWARDS ASSOCIATED WITH THIS PROJECT, INCLUDING ENGINEER'S FEE RELATIVE TO THE RISKS ASSUMED, AND AGREE TO ALLOCATE CERTAIN OF THE RISKS, SO, TO THE FULLEST EXTENT PERMITTED BY LAW, THE TOTAL AGGREGATE LIABILITY OF ENGINEER (AND ITS RELATED CORPORATIONS, SUBCONSULTANTS AND EMPLOYEES) TO OWNER AND THIRD PARTIES GRANTED RELIANCE IS LIMITED TO THE LESSER OF $1,000,000 OR ITS FEE, FOR ANY AND ALL INJURIES, DAMAGES, CLAIMS, LOSSES, OR EXPENSES (INCLUDING ATTORNEY AND EXPERT FEES) ARISING OUT OF ENGINEER'S SERVICES OR THIS AGREEMENT REGARDLESS OF CAUSE(S) OR THE THEORY OF LIABILITY, INCLUDING NEGLIGENCE, INDEMNITY, OR OTHER RECOVERY. ENGINEER'S AND SUBCONSULTANTS' EMPLOYEES ARE INTENDED THIRD PARTY BENEFICIARIES OF THIS ALLOCATION OF RISK.

18. LITIGATION SUPPORT
In the event ENGINEER is required to respond to a subpoena, government inquiry or other legal process related to the services in connection with a legal or dispute resolution proceeding to which ENGINEER is not a party, OWNER shall reimburse ENGINEER for reasonable costs in responding and compensate ENGINEER at its then standard rates for reasonable time incurred in gathering information and documents and attending depositions, hearings, and trial.

19. NO THIRD PARTY BENEFICIARIES
Except as otherwise provided in this Agreement, no third party beneficiaries are intended under this Agreement. In the event a reliance letter or certification is required under the scope of services, the parties agree to use a form that is mutually acceptable to both parties.

20. UTILITY LOCATION
If underground sampling/testing is to be performed, a local utility locating service shall be contacted to make arrangements for all utilities to determine the location of underground utilities. In addition, OWNER shall notify ENGINEER of the presence and location of any underground utilities located on the OWNER's property which are not the responsibility of private/public utilities. ENGINEER shall take reasonable precautions to avoid damaging underground utilities that are properly marked. The OWNER agrees to waive any claim against ENGINEER and will indemnify and hold ENGINEER harmless from any claim of liability, injury or loss caused by or allegedly caused by ENGINEER's damaging of underground utilities that are not properly marked or are not called to ENGINEER's attention prior to beginning the underground sampling/testing.

21. UNMANNED AERIAL SYSTEMS
If operating UAS, ENGINEER will obtain all permits or exemptions required by law to operate any UAS included in the services. ENGINEER's operators have completed the training, certifications and licensure as required by the applicable jurisdiction in which the UAS will be operated. OWNER will obtain any necessary permissions for ENGINEER to operate over private property, and assist, as necessary, with all other necessary permissions for operations.

22. OPERATIONAL TECHNOLOGY SYSTEMS
OWNER agrees that the effectiveness of operational technology systems and features designed, recommended or assessed by ENGINEER (collectively "OT Systems") are dependent upon OWNER's continued operation and maintenance of the OT Systems in accordance with all standards, best practices, laws, and regulations that govern the operation and maintenance of the OT Systems. OWNER shall be solely responsible for operating and maintaining the OT Systems in accordance with applicable laws, regulations, and industry standards (e.g. ISA, NIST, etc.) and best practices, which generally include but are not limited to, cyber security policies and procedures, documentation and training requirements, continuous monitoring of assets for tampering and intrusion, periodic evaluation for asset vulnerabilities, implementation and update of appropriate technical, physical, and operational standards, and offline testing of all software/firmware patches/updates prior to placing updates into production. Additionally, OWNER recognizes and agrees that OT Systems are subject to internal and external breach, compromise, and similar incidents. Security features designed, recommended or assessed by ENGINEER are intended to reduce the likelihood that OT Systems will be compromised by such incidents. However, ENGINEER does not guarantee that OWNER's OT Systems are impenetrable and OWNER agrees to waive any claims against ENGINEER resulting from any such incidents that relate to or affect OWNER's OT Systems.

23. FORCE MAJEURE
ENGINEER shall not be responsible for delays caused by factors beyond ENGINEER's reasonable control, including but not limited to delays because of strikes, lockouts, work slowdowns or stoppages, government ordered industry shutdowns, power or server outages, acts of nature, widespread infectious disease outbreaks (including, but not limited to epidemics and pandemics), failure of any governmental or other regulatory authority to act in a timely manner, failure of the OWNER to furnish timely information or approve or disapprove of ENGINEER's services or work product, or delays caused by faulty performance by the OWNER's or by contractors of any level or any other events or circumstances not within the reasonable control of the party affected, whether similar or dissimilar to any of the foregoing. When such delays beyond ENGINEER's reasonable control occur, the OWNER agrees that ENGINEER shall not be responsible for damages, nor shall ENGINEER be deemed in default of this Agreement, and the parties will negotiate an equitable adjustment to ENGINEER's schedule and/or compensation if impacted by the force majeure event or condition.

24. EMPLOYEE IMMUNITY (Only for Projects Located in Florida)
THE PARTIES ACKNOWLEDGE THAT PURSUANT TO APPLICABLE FLORIDA STATUTES AN INDIVIDUAL EMPLOYEE OR AGENT MAY NOT BE HELD INDIVIDUALLY LIABLE FOR NEGLIGENCE WITH REGARD TO SERVICES PROVIDED UNDER THIS AGREEMENT. To the maximum extent permitted by law, the Parties intend i) that this limitation on the liability of employees and agents shall include directors, officers, employees, agents and representatives of each Party and of any entity for whom a Party is legally responsible, and ii) that any such employee or agent identified by name in this Agreement shall not be deemed a Party. The Parties further acknowledge that the Florida statutes referred to above include but are not limited to: §558.0035(1)(a)-(e);§471.023(3)(an engineer is personally liable for negligence except as provided in § 558.0035); §472.021(3) (surveyor and mapper); §481.219(11)(architect and interior designer);§481.319(6) (landscape architect); and §492.111(4) (geologist).

CITY OF KETCHUM

PO BOX 2315 * 191 5TH ST. * KETCHUM, ID 83340
Administration 208-726-3841 (fax) 208-726-8234

PURCHASE ORDER

BUDGETED ITEM? ____ Yes ____ No

PURCHASE ORDER - NUMBER: 23090

To:	Ship to:
2319 HDR ENGINEERING, INC. BOX 74008202 CHICAGO IL 60674-8202	CITY OF KETCHUM PO BOX 2315 KETCHUM ID 83340

P. O. Date	Created By	Requested By	Department	Req Number	Terms
04/21/2023	bancona	bancona	Utilities/Wastewater	0	

Quantity	Description		Unit Price	Total
1.00	TASK ORDER#001 AB UPGRADE DETAILED DESIGN	67-4350-7815	250,340.00	250,340.00
			SHIPPING & HANDLING	0.00
			TOTAL PO AMOUNT	250,340.00

____
Authorized Signature

EXHIBIT A

TASK ORDER #01

This Task Order pertains to the Master Services Agreement by and between City of Ketchum, ID / Sun Valley Water & Sewer District, Sun Valley, ID ("OWNERS"), and HDR Engineering, Inc. ("ENGINEER"), dated _______________, 2023, ("AGREEMENT"). Engineer shall perform services on the project described below as provided herein and in the MSA. This Task Order shall not be binding until it has been properly signed by both parties. Upon execution, this Task Order shall supplement the Agreement as it pertains to the project described below.

TASK ORDER NUMBER: Task Order #01

PROJECT NAME:

Ketchum / SVWSD Water Reclamation Facility (WRF) – Aeration Upgrades: Detailed Design

PART 1.0 TASK ORDER DESCRIPTION:

Provide detailed design for activated sludge aeration system upgrades as described in two technical memoranda:

1. Aeration Basin (AB) Blower Technical Memorandum
2. Modified Ludzack-Ettinger (MLE) Technical Memorandum (AB #3 and #4)

PART 2.0 SCOPE OF SERVICES TO BE PERFORMED BY ENGINEER:

See Exhibit A.

PART 3.0 OWNER'S RESPONSIBILITIES:

See Exhibit A.

PART 4.0 PERIOD OF SERVICE:

May 2023 – December 2023

PART 5.0 ENGINEER'S FEE:

See Exhibit A for fee breakdown.

Task Order #01: Detailed Design for Aeration Upgrades **$250,340.00**

SECTION III. COMPENSATION

Compensation for ENGINEER's Services shall be in accordance with Part 5 of each Task Order, and in accordance with paragraph 11 of the attached HDR Engineering, Inc. Terms and Conditions.

SECTION IV. TERMS AND CONDITIONS OF ENGINEERING SERVICES

The HDR Engineering, Inc. Terms and Conditions, which are attached hereto in Exhibit B, are incorporated into this Agreement by this reference as if fully set forth herein.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first written above.

City of Ketchum "OWNER"		Sun Valley Water & Sewer District (SVWSD) "OWNER"	
BY:	______________	BY:	[signature]
NAME:	______________	NAME:	James Loyd
TITLE:	______________	TITLE:	Chairman
ADDRESS	______________	ADDRESS:	______________

HDR ENGINEERING, INC.
"ENGINEER"

BY: ______________

NAME: Kate Eldridge

TITLE: Sr Vice President

ADDRESS: 412 E Parkcenter Blvd., Suite 100
Boise, Idaho 83706

EXHIBIT A

TASK ORDER NO. 01

ENGINEERING SERVICES
AERATION UPGRADES
DETAILED DESIGN
CITY OF KETCHUM / SUN VALLEY WATER & SEWER DISTRICT

This Task Order pertains to a Master Services Agreement (MSO) by and between City of Ketchum and Sun Valley Water & Sewer District (Ketchum/SVWSD), Ketchum and Sun Valley, Idaho, and HDR Engineering, Inc. ("HDR"), dated _________________, 2023 ("the Agreement"). HDR shall perform services on the project described below and in the Agreement. This Task Order shall not be binding until it has been properly signed by both parties. Upon execution, this Task Order shall supplement the Agreement as it pertains to the technical services described below.

Background

The Ketchum/SVWSD of Ketchum and the Sun Valley Water & Sewer District (Ketchum/SVWSD) jointly own and operate a wastewater treatment plant (water reclamation Facility or WRF) that serves Ketchum and Sun Valley residents. The plant is an extended aeration activated sludge process that consists of screening, grit removal, aeration basins, secondary clarification, filtration, and ultraviolet (UV) disinfection. The solids handling facilities include an aerobic digester and solids gravity thickener.

The Wastewater Facility Planning Study (FPS) completed in 2022 by HDR identified upgrades needed at the WRF through year 2042. The major near-term improvements identified for the initial projects in years 2023 and 2024 included:

- Aeration blower replacement.
- Aeration basins 3 & 4 conversion from plug-flow complete aeration to the Modified Ludzack-Ettinger (MLE) process.

Two Technical Memorandums (TM) addressed the Aeration Upgrades. The Aeration Basins Blower TM provided the predesign for: 1) replacement of aeration basin blowers due to both failure and age, 2) replacement of aged electrical gear, and 3) construction of a new electrical room for increased blower room space.

The Modified Ludzack-Ettinger (MLE) Conversion TM provided the predesign for promoting denitrification by creating an activated sludge anoxic zone and mixed liquor recycle (MLR). The MLE conversion directly impacts the aeration basin blower sizing by taking advantage of heterotrophic bacteria using nitrate as the teminal electron acceptor instead of oxygen (hence less air required for oxidation of organic material). The TM's were submitted to Idaho

Department of Environmental Quality (DEQ) and approved for development of plans and specifications.

The TM's provide approximately 30 percent (%) design detail. The purpose of this Task Order is to advance the design details and produce contract documents (drawings and specifications) for the construction of the Aeration Upgrades. The detailed design is broken into several stages to allow Owner input at 60% and 90% completion level. At the conclusion of the 90% design, an opinion of probable construction cost (OPCC) will be prepared. The final design (100%) produces the contract documents used by Ketchum/SVWSD to bid project construction. Final design documents also require review by DEQ prior to construction.

The following scope of services describes the engineering required to prepare contract documents for the Aeration Upgrades Project including civil, structural, architectural, mechanical, and electrical.

Proposed Scope of Services

The purpose of this scope of services is to provide Ketchum/SVWSD with a detailed design (contract documents) defining Aeration Upgrades including: blower installation, blower piping layout, electrical room structural/architectural/HVAC, Aeration Basin (AB) mixers, MLR pumps, and electrical upgrades.

The proposed scope of services for the Aeration Upgrades detailed design includes the following tasks.

Task 100: Project Management

Objective

Objectives: Manage the detailed design phase of the project to meet schedule, engage Ketchum/SVWSD personnel during design development, and to meet quality and cost objectives.

HDR Subtasks

- Communicate with Ketchum/SVWSD and the project team through telephone calls and email communications.
- Monitor team scope, budget, and schedule; delegate task assignments and responsibilities by discipline; and coordinate issues with Ketchum/SVWSD's WRF Supervisor.

- Conduct twice-monthly (up to twelve (12)) coordination conference calls (approximate duration one hour) between HDR project manager and Ketchum/SVWSD project team.
- Document decisions made during conference calls in a decision log.
- Prepare monthly progress reports and invoices that summarize the work progress to date, budget expenditures to date, and identify information requirements or decisions that need to be made by Ketchum/SVWSD.
- Provide review of criteria and concepts being applied to the services in this Task Order.
- Prepare agenda and notes for meetings.

Ketchum/SVWSD Involvement

- Interface with Consultant on project issues.

Assumptions

- Monthly progress reports for the duration of the project, up to 6 months.
- If the scope changes during the life of the project, modification to the original contract agreement will be required per the terms and conditions of the agreement.
- Invoice format will follow standard format by the Consultant.
- Direct expenses for travel and printing will be billed to owner.

Deliverables

- Progress reports and invoices (e-mail and 1 hard copy each month).
- Conference call agenda and notes (electronic file in .pdf format transmitted via e-mail).
- Decision log, as requested (.pdf format transmitted via e-mail).

Task 200: Detailed Design, 60% Completion

Objective

The basis (and preliminary details) of the detailed design is found in the two Technical Memoranda (TM) prepared for this upgrade: Aeration Basins Blower TM and Modified Ludzack-Ettinger (MLE) Conversion TM.

The Detailed Design will provide a comprehensive set of design documents for review by Ketchum/SVWSD. This submittal provides the Ketchum/SVWSD the ability to influence the features of the design. The engineering design requirements for the Aeration Upgrades shall meet the Idaho Code (IDAPA 58.01.16 Section 490: Facility and Design Standards for

Municipal Wastewater Treatment or Disposal Facilities; Biological Treatment) and industry engineering standards.

Approach

Advance the design of the Aeration Upgrades project from the 30 percent completion stage of the Technical Memoranda (predesigns) to approximately the 60 percent completion with project definition on civil, structural, architectural, process mechanical, HVAC, electrical and instrumentation/control. The duration of this design is estimated to be approximately 3 months.

- Review of the past geotechnical site investigations and survey information (provided by Ketchum/SVWSD) to confirm that information applies for this project and determine if additional investigation is required (as change order).
- Integral to updating the electrical is review and updating of the Process & Instrumentation Diagrams (P&ID).
- Develop drawings that define the size, configuration, process control and key features of the project components defined in the Technical Memorandums defining the upgrades. The number of sheets assumed for each area is shown below in parentheses. The 60 percent completion level will find some sheets fully developed while other sheets are partially developed and some not yet completed.
    - General and Civil Drawings (7 sheets)
    - Structural & Architectural Drawings (11 sheets)
    - Process/Mechanical/HVAC Drawings (10 sheets)
    - Electrical (14)
    - Controls Drawings (15 sheets):
- Develop technical and front end specifications to draft level.
- Develop Owner Furnished Equipment (OFE) procurement package to draft level.
    - Blowers (bid package prepared as part of TM project)
    - Mixers
    - MLR Pumps
    - VFD's (and other long-lead electrical equipment)
- OFE bidding services including responding to bidder inquires, preparing addenda to OFE pre-procurement documents, evaluating bids, and preparing recommendation for award.
- Develop comprehensive equipment list including equipment data and electrical requirements. Including equipment and instrument tagging.
- Prepare service load calculations, electrical room interior lighting, power distribution plans, energy compliance documents (for lighting systems), prepare P&ID's to document the process changes and the control system, prepare process control narratives for system control, prepare network diagram showing control system

overview and related components, prepare cable schedule detailing control wiring, and prepare control panel layouts (including bill of materials and schematics for UL listing panel construction).

- Update construction sequencing plan and implementation schedule previously developed for the Tech Memos. Collect additional data on costs for integration into the revised OPCC (Task 300).
- Provide technical quality control review by HDR senior design staff.
- 60 percent design development will include a draft submittal to the Ketchum/SVWSD for review and comment.
- Conduct up to one (1) review meeting with Ketchum/SVWSD staff and up to two (2) Consultant staff members to discuss Ketchum/SVWSD comments on draft 60 percent submittal.
- Document decisions made during the review in a decision log.

Ketchum/SVWSD Involvement

- Host a kickoff meeting at the wastewater treatment plant.
- Provide geotechnical reports from past construction projects at the plant site.
- Provide survey and topographic information from past construction project at the plant site in AutoCAD format.
- Perform a timely review of draft submittal and single set of reconciled review comments. HDR's schedule includes an allowance of up to two (2) weeks for Ketchum/SVWSD review of the draft submittal.
- Ketchum/SVWSD will download Navisworks Freedom (free software) to review the 3D BIM model.
- Participate in the review meeting.
- Participate in eight (6) conference call review meetings (every 2 weeks).

Assumptions

- No geotechnical investigation or survey is required or included in this Scope of Services.
- The design will be completed using 3D building information modeling (BIM) software.
- Drawings will be prepared per HDR standards, and specifications will be prepared using the six digit format of the Construction Specifications Institute (CSI). Front-end specifications will be based upon Engineers Joint Contract Documents Committee (EJCDC) construction contract documents, latest version.
- The design will incorporate HDR and Ketchum/SVWSD engineering and equipment standards to maintain consistency and compatibility with the Ketchum/SVWSD's facilities.

- HDR excludes incorporation of OT Cybersecurity within the design. Where provided Owner standards shall be applied, however, any further risk evaluation or development of cybersecurity mitigations is excluded.
- Two (2) HDR staff (PM, EIT) plus electrical engineer (DC Engineering) will attend the kick-off meeting at the plant which is assumed will require 8 hours, including travel time.
- Conference calls on two week frequency schedule shall be approximately 45 - 60 minutes in duration attended by PM, EIT, Structural, and Electrical.
- HDR's quality assurance manual and design delivery manual will provide the basis of the quality control program.
- Duration of the 60 percent design completion is approximately 3 months.
- Reference for the 60 percent design shall be from the DEQ approved Tech Memos.
- Three (3) HDR staff (PM, EIT, structural) will attend the 60% design review meeting by web based conference call, estimated duration two (2) hours.
- Engineer will prepare and distribute review meeting minutes within seven calendar days of meeting completion date.
- Owner requested changes after the 60 percent design phase will be negotiated via additional services.
- Direct expenses for travel and printing will be billed to Owner (with 10% markup).

Deliverables

- 60 Percent 3D BIM model (electronic file in Navisworks format transmitted via e-mail).
- 60 Percent Design Drawings (electronic file in .pdf format transmitted via e-mail).
- 60 Percent Specifications (electronic file in .pdf format transmitted via e-mail).
- Updated equipment list, and construction sequencing plan (electronic files .pdf format).
- Eight (8) review meeting agenda and notes (.pdf format transmitted via e-mail), includes kickoff, regular twice monthly, and 60% review meetings (electronic copy in .pdf format transmitted via e-mail).
- Decision log, as requested (electronic file in .pdf format transmitted via e-mail).

Task 300: Detailed Design, Final Completion

Objective

Provide a comprehensive set of design documents to allow thorough review by Ketchum/SVWSD at the 90% completion stage. Upon incorporation of final review comments, this Task shall be complete and the deliverable (drawings and specifications) signed and sealed by the appropriate registered engineers/architects. The contract documents will be submitted to Idaho DEQ for conformance with Idaho code. Once approved by DEQ, Ketchum/SVWSD will have contract documents available in electronic format bidding.

Approach

Advance the design of the Aeration Upgrades project from the Owner approved 60% completion stage (Task 200 above) to approximately 90% completion. The duration of this design is estimated to be approximately 2.5 months. The 90% completion shall include greater definition of previous civil, structural, architectural, process mechanical, HVAC, electrical and instrumentation / control. After review of the 90% design package with Ketchum/SVWSD (2 week review period), the Final Documents will be prepared. The duration for preparation of final documents is estimated to require an additional two weeks.

- Prepare equipment procurement contract including specifications and drawings.
- Prepare final drawings that define the size, configuration, process control and key features of the project components.
- Control panel layouts, bill of materials, and schematics developed after finalized P&ID and controls narratives.
- Prepare final front end specifications.
    - Division 00 – Procurement and Contracting Requirements
    - Division 01 – General Requirements
- Prepare technical specifications.
    - Division 03 – Concrete
    - Division 04 – Masonry
    - Division 05 – Metals
    - Division 06 – Wood, Plastics, and Composites
    - Division 07 – Thermal and Moisture Protection
    - Division 08 – Openings
    - Division 09 – Finishes
    - Division 23 – Heating, Ventilating, and Air Conditioning
    - Division 26 – Electrical
    - Division 31 – Earthwork
    - Division 32 – Exterior Improvements
    - Division 40 – Process Interconnections

- Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment
- Division 46- Water and Wastewater Equipment

- Prepare final opinion of probable construction cost, Class 2.
- Provide technical quality control review of final submittal.
- Equipment procurement contract and final design development will each include a draft submittal (90%) to the Ketchum/SVWSD for review and comment.
- Conduct up to one (1) review meeting with Owner staff and up to two (2) Consultant staff members to discuss Ketchum/SVWSD comments on 90% submittal.
- Submit final design package to Idaho Department of Environmental Quality (DEQ) for review and approval.

Ketchum/SVWSD Involvement

- Review equipment procurement contract.
- Perform a timely review of submittal and will provide a single set of reconciled review comments. HDR's schedule includes an allowance of up to two (2) weeks for Ketchum/SVWSD review of the submittal. Any duration longer than this will result in HDR schedule adjusting accordingly.
- Ketchum/SVWSD will download Navisworks Freedom (free software) to review the 3D BIM model.
- Participate in the review meeting.

Assumptions

- One equipment procurement contract will be developed for the equipment manufacturer selected in **Error! Reference source not found.**.
- Drawings will be prepared per HDR standards and specifications will be prepared using the six digit format of the Construction Specifications Institute (CSI).
- The design will incorporate Consultant and Owner engineering and equipment standards to maintain consistency and compatibility with the Owner's facilities.
- HDR excludes incorporation of OT Cybersecurity within the design. Where provided Owner standards shall be applied, however, any further risk evaluation or development of cybersecurity mitigations is excluded.
- Project delivery assumes conventional design-bid-build project delivery method.
- No separate value engineering tasks are included.
- Besides separate packages for Owner Furnished Equipment (OFE) defined above, the remainder of the drawings and specifications will be prepared for a single lump sum bid.
- Review meeting will be conducted at the Wastewater Treatment Plant and will last up to three (3) hours.

- Consultant's quality assurance manual and design delivery manual will provide the basis of the quality control program.
- Up to 57 drawings (+/- 5 percent) will be prepared for the Aeration Upgrades Improvements Project. The estimated drawing list is listed below.

ESTIMATED DRAWING LIST

1	C	Location, Sheet Index
2	C	General Abbreviations
3	C	Process Flow Diagram / Design Criteria/
4	C	Civil Legend, Equipment and Piping Abbreviations, Design Criteria
5	C	Demolition Plan; Air Intake & Louvers
6	C	Civil Site Plan; Construction Staging & Survey Control
7	C	Civil Details
8	S	Structural General Notes
9	S	Electrical Room Foundation Plan
10	S	Electrical Room Roofing Plan
11	S	Electrical Room Sections
12	S	Electrical Room Details
13	S	Standard Concrete Details
14	S	Standard Masonry Details
15	S	Standard Wood/Metals Details
16	A	Code Compliance
17	A	Blower Building Elevation Views (North and West)
18	A	Blower Building Misc. Architectural Details and Schedules (Doors)
19	D	Blower Isometric Drawing
20	D	Blower Plan & Sections
21	D	Blower Intake Plan & Sections
22	D	Diffuser Replacement Plan
23	D	Mixer Plan & Details
24	D	MLR Pump Plan & Sections21
25	D	MLR Sections & Details
26	D	Misc. Details
27	M	Mechanical Legend
28	M	HVAC Plan & Schedules
29	E	Electrical Legend & Symbols
30	E	Notes, Abbreviations, and Area Classification
31	E	Energy Compliance Documents for Lighting System (CommCheck)
32	E	Blower Motor Control Schematic and Field Wiring Diagram

33	E	Mixers and MLR Pumps Motor Control Schematic and Field Wiring Diagram
34	E	Motor Cotnrol Schematic Existing Loads
35	E	Motor Control Schematic Existing Loads
36	E	Site Electrical/Controls Plan
37	E	Blower Building Demolition One-Line Diagram
38	E	Blower Building Electrical/Controls Demolition Plan
39	E	Blower Building New One-Line Diagram
40	E	Blower Building New Electrical/Controls Plan
41	E	Blower Building Panelboard and Luminaire Schedules
42	E	Aeration Basin Electrical Plan
43	I	Instrumentation & Controls Legend
44	I	Aeration Basin P&ID
45	I	Blower P&ID
46	I	SCADA Network Diagram (Demo and New)
47	I	Instrument/Cable Schedule
48	I	SCADA Panel Layout
49	I	SCADA Panel Bill of Materials
50	I	SCADA Panel Schematic
51	I	SCADA Panel Schematic
52	I	SCADA Panel Schematic
53	I	SCADA Panel Schematic
54	I	SCADA Panel Schematic
55	I	SCADA Panel Schematic
56	I	SCADA Panel Schematic
57	I	SCADA Panel Schematic

- No new drawings or specification sections are expected following this 90 percent submittal.
- The detailed design will advance the completion level and refine the opinion of probable construction cost (OPCC) to Class 2, -10% to +20% range of accuracy based upon AACE International Recommended Practice No. 18R-97 (Tech Memo OPCC's provided a Class 3 estimate with an accuracy range of -15%, +30%). Current market volatility in materials and labor market restrict our estimate to Class 2 level.

  In addition it should be understood that providing opinion of cost for the PROJECT, CONSULTANT has no control over cost or price of labor and materials, unknown or latent conditions of existing equipment or structures that might affect operation or maintenance costs, competitive bidding procedures and market conditions, time or quality of performance by operating personnel or third parties, and other economic and operational factors that might materially affect the ultimate PROJECT cost or schedule. The CONSULTANT, therefore, will not warranty that the actual PROJECT costs will not vary from CONSULTANT'S opinions, analyses, projections, or estimates.

- No document modifications will result from Idaho DEQ review and approval of the final plans and specifications submittal.
- Bidding services and services during construction are not included and will be scoped separately.
- Direct expenses for travel and printing will be billed to Ketchum/SVWSD at cost plus 10%.

Deliverables

- Ninety percent (90%) review meeting agenda and notes (.pdf format transmitted via e-mail).
- Draft equipment procurement contract transmitted to Ketchum/SVWSD via e-mail in.pdf format.
- Final equipment procurement contract transmitted to Ketchum/SVWSD via e-mail in.pdf format.
- Review set of design documents including 3D BIM model, construction plans, and specifications transmitted to Ketchum/SVWSD via e-mail in Navisworks and .pdf formats.
- Final design documents including 3D BIM model, construction plans, and specifications transmitted to Ketchum/SVWSD via e-mail in Navisworks and .pdf formats.
- Final design documents including construction plans and specifications transmitted to Idaho DEQ via e-mail.pdf formats.

Review meeting agenda (up to five (5) hard copies) and notes (electronic copy in .pdf format transmitted via e-mail).

Project Schedule

The project schedule for performing the Task Order is as follows:

Task	Schedule (Assuming NTP April 17, 2023)
Task 100 – Project Management	On-going
Task 200 – 60% Design	August 7, 2023
Task 300 – Final Design	November 13, 2023

*This schedule is based upon an assumed notice to proceed. If the notice to proceed is delayed, the project schedule will shift the corresponding number of calendar days.

Compensation

The estimated cost to complete this Scope of Services is presented in the table below.

Task	Budget
Project Management	$21,750
60% Design	$129,970
Final Design	$98,620
TOTAL	**$250,340**

HDR will invoice the Ketchum/SVWSD of Ketchum/SVWSD for professional services described in this Proposal on a time and materials basis. For the activities described in the Scope of Services, HDR estimates a professional services fee of not to exceed the amounts described in the table above without written authorization from the City of Ketchum and Sun Valley Water & Sewer District.

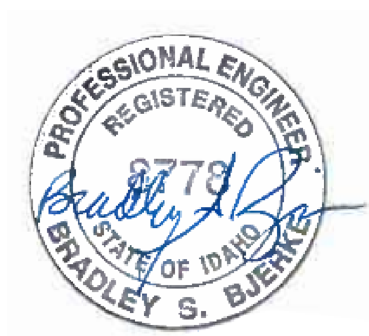
End of Task Order #01

Aeration Basin Blowers Technical Memorandum

City of Ketchum & Sun Valley Water and Sewer District Water Reclamation Facility

Ketchum, Idaho

March 16, 2023



03/16/2023

Contents

1 Introduction 1
1.1 Coordination with Facility Plan 1
1.2 Equipment and Piping Labeling Scheme 2
2 Aeration Design Criteria 5
2.1 Existing Conditions 6
2.1.1 Existing Blowers 6
2.1.2 Existing Electrical Infrastructure 7
2.1.3 Existing Aeration Blower Building 8
2.1.4 Blower Building Air Intake Changes 8
2.2 Biological Modeling 9
2.2.1 Biological Modeling Update - Airflow 10
2.3 Treatment Requirements 11
3 Aeration Equipment Evaluation 12
3.1 Blower Technology 12
3.1.1 Centrifugal Blowers 12
3.1.2 Positive Displacement Blowers 13
3.1.3 Hybrid Blowers 14
3.1.4 Turbo Blowers 14
3.1.5 Blower Recommendation 15
3.2 Equipment Procurement 16
3.3 Equipment Sequencing 16
4 Electrical Infrastructure 19
4.1 Low-Voltage (600-V) Variable Frequency Drives 21
4.2 Low-Voltage (600-V) Motor Control Centers 21
4.3 Active Harmonic Filters 22
4.4 Power Monitor and Display 22
4.5 Low-Voltage Distribution: Panelboards and Switchboards 22
4.6 Electrical Equipment Loads 23
5 Site Evaluation 27
5.1 Existing Facilities 27
5.2 Constraints 27
5.3 WRF Modifications 27
5.3.1 Blower Building Modifications 27
5.3.2 Mechanical Modifications 30
5.3.3 Electrical Cutover During Construction 32
5.4 Treatment During Blower Construction 32
5.5 Structural Requirements and Architectural Considerations 33
6 Implementation 34
6.1 Project Cost Evaluation 34
6.2 Implementation Plan 35
7 References 36

Tables

Table 1. Equipment and Valve Abbreviations 3
Table 2. Process Areas 4
Table 3. Pipe Service Designations 4
Table 4. Planning Period Design Flows from FPS 5
Table 5. Planning Period Design Loads from FPS 5
Table 6. Preliminary List of New & Upgraded Equipment for MCC-2 24
Table 7. OPCC Summary – Blowers 01 & 02 and MCC-2 Installation 34

Figures

Figure 1. Existing Blower Room 6
Figure 2. RAS Pump VFD Location 8
Figure 3. Pipe-Mounted Inlet Filter Silencer 9
Figure 4. Typical Centrifugal Blower Cross-Section 13
Figure 5. Typical PD blower Cross-Section 13
Figure 6. Typical Hybrid Blower Cross-Section 14
Figure 7. Typical Turbo Blower Cross-Section 15
Figure 8. Air Demand versus Blower Capacity Over Time 17
Figure 9. Preliminary Electrical Room Plan 20
Figure 10. Preliminary One-Line Diagram for MCC-2 25
Figure 11. Preliminary Blower Building Roof Modification Plan and Sections 28
Figure 12. Preliminary Electrical Room Addition Plan and Section 29
Figure 13. Preliminary Blower Building Isometric 31

Appendices

Appendix A. NDPES Permit
Appendix B. Recycled Water Permit and Fact Sheet
Appendix C. 10-Year Capital Improvement Plan

Acronyms

AAF	Average annual flow
BOD	Biochemical oxygen demand
DO	Dissolved oxygen
EA	Each
EIFS	Exterior insulation finish system
FPS	Facility Planning Study
HP	Horsepower
HVAC	Heating, ventilation, and air-conditioning
lb/d	Pounds per day
LS	Lump sum
MCC	Motor control center
mg/L	Milligrams per liter
MGD	Million gallons per day
MLE	Modified Ludzack-Ettinger
NH_3-N	Ammonia-nitrogen
OFE	Owner Furnished Equipment
PLC	Programmable logic controller
RAS	Return activated sludge
SCFM	Standard cubic feet per minute
SVWSD	Sun Valley Water and Sewer District
TKN	Total Kjeldahl nitrogen
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
UV	Ultraviolet
VFD	Variable frequency drive
WRF	Water Reclamation Facility

This page is intentionally left blank.

1 Introduction

The City of Ketchum's (Ketchum) and Sun Valley Water and Sewer District's (SVWSD) jointly owned Ketchum / SVWSD Water Reclamation Facility (WRF) is an extended aeration activated sludge process that consists of screening, grit removal, aeration basins, secondary clarification, filtration, and ultraviolet (UV) disinfection. The solids handling facilities include an aerobic digester and solids gravity thickener.

The Wastewater Facility Planning Study (FPS) completed in 2022 (HDR 2022) identified upgrades needed at the WRF through year 2042. The major near-term improvements identified for 2023 through 2027 include:

- Aeration blower replacement.
- Aeration basins 3 & 4 conversion from plug-flow complete aeration to the Modified Ludzack-Ettinger (MLE) process.
- Solids thickening and dewatering facilities.
- Aeration basin 1 & 2 conversion from complete-mix aeration to the MLE process.

This Technical Memorandum (TM) addresses the replacement of an aeration basin turbo blower that failed in 2021. Repair work completed in 2022 did not repair the turbo blower and prompted the need for immediate replacement. This in conjunction with the remaining centrifugal blower being 40-year's old drive the urgency. Final blower sizing defined in this TM accounts for growth during the 20-year planning period and activated sludge conversion to MLE that reduces aeration demand. The other upgrade associated with the blower replacement is blower building electrical improvements. The electrical upgrade is driven due to space limitations in the existing blower room and the age of some of the electrical equipment (almost 40 years).

1.1 Coordination with Facility Plan

The technology selection for the blower type was completed during the FPS planning stage and recommended the hybrid, or twisted tri-lobe, positive displacement blower for both efficiency and maintenance. The FPS identified replacing the old centrifugal blower with a new hybrid blower first, then adding a second hybrid blower and expanding the aeration blower room (two hybrids and two turbos in service). The final step was replacing each of the turbos with new hybrids for a total of four hybrid blowers. This 20-year upgrade strategy included an expansion of the building east towards Clarifier No. 1 with the second hybrid blower to provide enough floor space for four blowers. Although the FPS had four blowers at the end of the 20-year planning period layout, updated modeling reveals reduced air demand only requires three blowers.

The turbo blowers were installed in 2014 with the failure of the center unit in 2021, well short of the typical 20-year design lifespan of blowers. Since the turbo blower repair in April 2022 failed, the replacement strategy proposed in the FPS requires modification. The first new hybrid will replace the failed turbo and the second hybrid will replace the centrifugal blower. The third hybrid will replace the final working turbo. Two hybrids will be installed now with the two existing blowers removed.

Two hybrid blowers plus one turbo will provide sufficient redundancy at peak hour air requirements through 2039. Placing the remaining turbo blower in the standby position should put the least amount of stress on the turbo blower. Due to lack of confidence in the turbo blower, the third hybrid is planned to replace the remaining turbo in 2030. This FPS planning approach assumes the remaining turbo will operate for a period of just over 15 years.

A new dedicated electrical room will house a new distribution switchboard, variable frequency drives, Motor Control Center (MCC), distribution panelboards, and SCADA panel. The electrical room will extend to the west of the building and square off the west side with the air intake room. This new space in the blower room will allow three hybrids to be installed without expanding the Aeration Blower Building to the east towards Clarifier No. 1.

1.2 Equipment and Piping Labeling Scheme

The Ketchum / SVWSD WRF does not have a consistent equipment labeling scheme across the plant and has historically used different labeling schemes in each design package. This section describes the proposed labeling schemes for design packages for the Ketchum / SVWSD WRF from this point forward. Using a consistent labeling scheme plantwide for all design projects will help maintain consistency throughout the various projects and with overall records. The proposed labeling tables are not necessarily inclusive of all items at the WRF and can be expanded as needed in the future to accommodate items not shown.

Equipment will be identified by an equipment tag that will be used through the Contract Documents. Equipment will be numbered according to the following format:

- AAA-XYY

Abbreviations are defined as follows:

- AAA Equipment abbreviation (by type) as defined in Table 1.
- X Process area as defined in Table 2.
- YY Suffix for equipment number in the process area.

For example, P-103 represents the Influent Pump 03.

Table 3 lists the piping services, and the pipe materials historically used for each service, at the WRF.

Table 1. Equipment and Valve Abbreviations

Abbreviation	Description
Equipment	
ADG	Air Diffuser Grid
B	Blower
CS	Carbon Scrubber
F	Fan
FLT	Filter
GC	Grit Classifier / Washer
HST	Hoist
MECH	Mechanism (Clarifiers)
MXR	Mixer
PBS	Polymer Blending System
PRV	Pressure Reducing / Regulating / Relief Valve
SCP	Screw Press
SCRN	Screen
SF	Supply Fan
T	Tank
UH	Unit Heater
UV	UV Disinfection System
WC	Washer/Compactor
Valves & Miscellaneous	
BFV	Butterfly Valve
BV	Ball Valve
CV	Check Valve
FCV	Flow Control Valve
GV	Globe Valve
PV	Plug Valve
RPBP	Reduced Pressure Backflow Preventer
SLG	Slide Gate
SP	Sample Port
STR	Strainer
SV	Solenoid Valve

Table 2. Process Areas

Number	Process Area
1	Screening & Influent Pumping
2	Grit Removal
3	Aeration Basin & Clarifiers
4	Tertiary Filtration & Effluent Pumping
5	Disinfection
6	Aerobic Digesters
7	Solids Thickening & Dewatering
8	Chemical Dosing & Plant Drain
9	Recycled Water
10	N/A

Table 3. Pipe Service Designations

Service Designation	Material	Service Description
ALP	Type 304 SS	Air Low Pressure
CHM	Vinyl Tubing w/ Conduit Carrier	Chemical
DGS	PVC or DI	Degritted Sewage
D	CI or DWV	Drain
FE	DI or Type 304 SS	Filter Effluent
GR	CI	Grit
ML	DI or Type 304 SS	Mixed Liquor
NG	Polyethylene or Black Steel	Natural Gas
ODA	Type 304L SS	Odorous Air
OF	PVC or DI	Overflow
PW	PVC or DI	Plant Water (Non-Potable)
W	C900 PVC	Potable Water
S	PVC or DI	Raw Sewage
RAS	DI or Type 304 SS	Return Activated Sludge
RUS	DI or C900 PVC	Reuse Water
RD	CI or DWV	Roof Drain
SC	DI or Type 304 SS	Scum
SE	DI or Type 304 SS	Secondary Effluent
SD	PVC	Storm Drain
UV	DI or Type 304 SS	UV Disinfection Effluent
V	CI or DWV	Vent
VTR	CI or DWV	Vent Through Roof
WAS	DI or Type 304 SS	Waste Activated Sludge
SL	DI or Type 304 SS	Sludge

2 Aeration Design Criteria

The purpose of this section is to describe the current equipment and building conditions and review biological modeling used to determine the design sizing. Table 4 presents the 2021 design flows identified in the FPS, the current 2022 design flows, and the 20-year planning period (2042) design flows projected in the FPS. The FPS projected a flow increase of approximately 2.5 percent per year to the average annual flow (AAF) over the planning period. The AAF increased by approximately 3.8 percent from 2021 to 2022. However, the AAF decreased by approximately 3.8 percent from 2020 to 2021. It can be assumed that annual flow increases will trend to the projected 2.5 percent in the upcoming years.

Table 4. Planning Period Design Flows from FPS

Parameter	FPS (2021)	Current (2022)[1]	Planning Period (2042)
Average Annual (MGD)	1.05	1.09	1.73
Peak Month (MGD)	1.34	1.11	2.57
Peak Day (MGD)	1.49	2.17	3.47
Peak Hour (MGD)	3.05	3.16	5.96

[1] Data used through December 5, 2022.
MGD = million gallons per day

Table 5 presents the 2021 design loads identified in the FPS, the current 2022 design loads, and the 20-year planning period (2042) design loads projected in the FPS.

Table 5. Planning Period Design Loads from FPS

Parameter	Average Annual			Peak Month		
	FPS (2021)	Current (2022)	Planning Period (2042)	FPS (2021)	Current (2022)	Planning Period (2042)
BOD (lb/d)	2,348	2,764	3,890	3,857	4,052	5,760
TSS (lb/d)	1,715	1,523	2,900	2,345	2,293	4,300
TP (lb/d)[1]	34	32	58	44	45	86
TKN (lb/d)[2]	351	294	580	446	401	860

[1] TP analysis problems overestimated TP load from February 22, 2022 through March 15, 2022. This data was not used.
[2] Data based on typical WRF influent concentration of 40 mg/L for FPS (2021) and Planning Period (2042) data (M&E 2014). Actual operating data used for Current (2022).
BOD = biochemical oxygen demand; TSS = total suspended solids; TP = total phosphorus; TKN = total Kjeldahl nitrogen; lb/d = pounds per day

As noted in the FPS, there has been an apparent change to the influent wastewater characteristics, especially related to the ratio of biochemical oxygen demand (BOD) to total suspended solids (TSS). Soluble organic flow-weighted concentrations have steadily increased annually since 2017, from 108 milligrams per liter (mg/L) up to the current 2022 average flow-weighted concentration of 303 mg/L. Influent TSS concentration trends remain approximately the same over the same time span. Influent total phosphorus (TP) concentration trends have also remained approximately the same since 2017, other than an appeared spike in influent TP from February 22, 2022 through March 15, 2022 (operations determined that problems related to the TP analysis were the cause of the apparent high TP loads, not actual TP load). The faulty data points indicated that influent TP loads were ranging from 113 to 198 pounds per day (lb/d). Historical maximum day TP loads have ranged from 47 to 64 lb/d from 2017 to 2021.

2.1 Existing Conditions

2.1.1 Existing Blowers

The Atlas Copco turbo blower is 160 horsepower (HP) and provides 2,400 standard cubic feet per minute (SCFM) of air at 5.8 pounds per square inch (gauge) (PSIG) to the aeration basins. The two turbo blowers were installed in 2014 and have been the main service blowers for the WRF's aeration basins since they were installed. One turbo blower failed in 2021 and was repaired in April 2022, but the turbo failed a second time in July 2022. The original failure stemmed from a sensor failure, and this sensor failure led to a core failure. The sensor and core were replaced, but ultimately the damage led to a drive failure in July 2022 even after replacement. The second turbo is currently still operational and the primary blower for activated sludge aeration.

The approximately 40-year-old 125-HP centrifugal blower is used to supplement the turbo air flow conditions. The two blowers are currently operated in a lead-lag configuration with no redundant blower. The centrifugal blower is currently running on a timer, where it starts at 10:00 am and shuts off at 1:00 am daily. Confidence in the one remaining turbo blower is low, therefore the WRF is required to depend on the centrifugal blower sized to provide up to 2,100 SCFM as supplemental or backup air to the aeration basins. The blower room can be seen in Figure 1.

Figure 1. Existing Blower Room

The functioning turbo blower can only turn down to approximately 1,250 SCFM (about 2:1 turndown, or 50 percent). The nighttime diurnal flows only require approximately 200 SCFM to maintain DO levels at 2.0 mg/L, with the rest of the airflow wasted within the blower room. The air blowoff valves cycle on and off approximately once every 30 minutes during the nighttime minimum air demand, which occurs from approximately 1:00 am to 5:00 am daily.

2.1.2 Existing Electrical Infrastructure

The secondary treatment system electrical equipment (MCC-2) is energized by a 1,000-amp feeder served from the Operations Building electrical room switchgear. MCC-2 details:

- Contains motor starters and fused switches but does not house any VFDs.
- Provides feeders for the externally mounted VFDs for the return activated sludge (RAS) pumps and integrally mounted VFDs within the existing blower equipment.
- Contains only analog meters to measure load current. It does not contain meters that provide the measurement quantities and granularity needed for such things as energy conservation, harmonic measurement, power factor, power usage, etc.
- Has been in service for the secondary treatment system since 1984, is at the end of its useful life, and needs to be replaced.

As seen in Figure 1, MCC-2 is located within a congested area within the blower room behind the blowers, and the SCADA panel is installed adjacent to MCC-2. The RAS pump VFDs are located to the immediate south of the centrifugal blower, as shown in Figure 2. The existing RAS pump VFDs and blower VFDs presently utilize passive harmonic filters that also take up considerable space within the blower room. A new electrical room would help to clear out the blower room space and allow the installation of electrical improvements required to facilitate equipment cutovers during construction, accommodate switchboard, active harmonic filter, additional VFDs and starters associated with the MLE conversion, the new blower VFDs, and distribution panelboards needed for the final facility installation.

Figure 2. RAS Pump VFD Location

2.1.3 Existing Aeration Blower Building

While the Aeration Blower Building is almost 40 years old, it is in good structural condition. Modifications will be made to the building for the new electrical room on the west side. This includes using the air intake room on the south end of the building. No other changes are anticipated to the existing building.

2.1.4 Blower Building Air Intake Changes

To free up the blower building air intake room for re-purposing as electrical space, a pipe-mounted intake filter system is proposed, like the one shown in Figure 3. The 24-inch pipe will be continued out the south wall where the filter system is installed on the end of the intake header. The intake filter systems have removable filter lids and can be provided with polyester or paper filters. The blower unit is provided with an integral filter system; therefore, the air intake filter serves as a “pre-filter”. The opening size differences between polyester and paper filters is not critical- polyester filters have a 5-micron rating and paper filters have a 2-micron rating for the required intake size. We recommend using a polyester filter as they have better resistance to moisture and can be cleaned. The larger opening sizes will also reduce the frequency of cleaning and replacement.

The air intake room modifications include removal of the three wall louvers; the louver on the north wall will be removed and the opening expanded to ground level to become a doorway into the north section of the electrical room. The louvers on the west and south walls will be removed and the opening filled with block and repaired with an insulation finish system (EIFS).

Figure 3. Pipe-Mounted Inlet Filter Silencer

(Source: Solberg Manufacturing)

2.2 Biological Modeling

A preliminary biological model was developed to predict future design conditions for the WRF's aeration basins and solids handling systems. The model was used for preliminary MLE design during the FPS and refined for final basin configuration. The key assumptions for the MLE process under 2042 conditions are as follows:

- Peak month flow: 2.57 million gallons per day (MGD)
- Peak Month BOD load: 5,760 lb/d
- Peak month total Kjeldahl nitrogen (TKN) load: 860 lb/d
- Basin mixed liquor suspended solids (MLSS) concentration: 4,350 mg/L
- Activated sludge solids retention time (SRT):
  - Average: 15 - 20 days
  - Maximum: 25 - 30 days
- Mixed liquor recycle (MLR) flow rate: 2Q peak month
- RAS flow rate: 0.8Q peak month

The model was calibrated using 2021 influent data, plus an assumed influent TKN concentration of 40 mg/L (M&E 2014). Influent TKN data was not collected in 2021; however, influent TKN data was collected through 2022 and the data indicates the assumed concentration may be slightly above actual conditions (32.2 mg/L average annual).

The FPS modeling predicted an airflow requirement of 4,100 SCFM at average annual conditions, as identified in Table 4 and Table 5 from the FPS. The assumed peak-to-average ratio of 1.76 produced a planning period air demand of 7,200 SCFM. Blower design assumed a daily peaking factor of 1.2 for an ultimate air demand of 8,600 SCFM in 2042. The preliminary blower sizing used three blowers at 3,000 SCFM each for duty and one additional blower for redundancy. Each blower was planned to be 200-HP. The modeling also predicted an effluent total nitrogen (TN) concentration of 6.0 mg/L, effluent ammonia-nitrogen (NH_3-N) concentration of 0.2 mg/L, and WAS production of 2,430 lb/d.

2.2.1 Biological Modeling Update - Airflow

The biological model was recalibrated using 2022 influent data. The model continued to use an assumed influent TKN concentration of 40 mg/L instead of the 2022 influent samples. Due to the variable nature of influent concentrations for all major wastewater constituents over the last five years, it was decided that the more conservative TKN values should be used until additional influent TKN data can be collected.

With the biological model recalibrated to the 2022 plant operating data, a more detailed approach to the process modeling was able to be implemented. The updated model uses the following key assumptions and reflects the same values that were used during the FPS with the exception of an increase in the recycle rate (MLR).

- Peak month flow: 2.57 million gallons per day (MGD)
- Peak Month BOD load: 5,760 lb/d
- Peak month total Kjeldahl nitrogen (TKN) load: 860 lb/d
- Basin mixed liquor suspended solids (MLSS) concentration: 4,350 mg/L
- Aerobic sludge retention time (SRT): 18 days
- Mixed liquor recycle (MLR) flow rate: 4Q peak month
- RAS flow rate: 0.8Q peak month

The model was run to predict air requirements at five-year intervals through the planning period (current 2023, 2027, 2032, 2037, and 2042). The intervals were calibrated using the most current Capital Improvement Plan (CIP), which identifies the timing of blower upgrades and installations, and modifications of the aeration basins to the MLE process. The CIP can be found in Appendix C.

- 2023 model run: Basins 3 & 4 in service, MLE configuration
    - 1,746 SCFM at peak month conditions
    - 2,514 SCFM for peak hour
- 2027 model run: Basins 3 & 4 in service, MLE configuration
    - 2,798 SCFM at peak month conditions
    - 4,030 SCFM for peak hour
- 2032 model run: Basins 1, 2, 3 & 4 in service, MLE configuration
    - 2,750 SCFM at peak month conditions
    - 3,960 SCFM for peak hour

- 2037 model run: Basins 1, 2, 3 & 4 in service, MLE configuration
  - 3,050 SCFM at peak month conditions
  - 4,390 SCFM for peak hour
- 2042 model run: Basins 1, 2, 3 & 4 in service, MLE configuration
  - 3,410 SCFM at peak month conditions
  - 4,910 SCFM for peak hour

The recalibrated model found that running the MLR at 4Q instead of the 2Q identified in the FPS would not pose a significant risk of DO poisoning in the anoxic zone and further reduced the air demand in the aerobic zones. Running at this recycle rate is contingent upon maintaining the DO concentration in the third cell at 1.5 mg/L. The existing system does not have enough turndown at night (diurnal flow variation) to hold a minimum DO. The blower replacements will either need sufficient turndown for nightly air requirements or an air wasting mechanism, such as an air blow-off system, so the third cell is not over-aerated. The on-off control of the hybrid blowers with constant speed motor is also not as critical as this same operation with turbo blowers (high-speed motors, ~ 15,000 – 20,000 rpm).

The model predicted a peak day to peak month ratio (PD:PM) of 1.2 for air demand. This means that the 2042 air demand at peak day conditions requires at least 4,090 SCFM (3,410 SCFM x 1.2). Typically, aeration systems are sized to provide 1.2 times the peak day air requirement to maintain the DO setpoint at peak hourly conditions. This means that the aeration basin blower system should be sized to provide at least 4,910 SCFM (4090 SCFM x 1.2) with the largest unit out of service for 2042 conditions. Blower sizing is set for 2,500 SCFM with three units total at 7.0 PSIG. Each blower will be driven by a 150-HP motor operated on a VFD.

2.3 Treatment Requirements

The aeration basins require blowers to generate air to successfully meet permit limits. Activated sludge system requires air to biologically degrade biochemical oxygen demand (BOD) and ammonia-nitrogen (NH_3-N) in the wastewater. Even though treatment limits at the Ketchum / SVWSD WRF only requires reduction of BOD, concurrent treatment for NH_3-N cannot be avoided and air demand must be taken into account.

Typical activated sludge systems, such as the existing complete aeration system, use a DO setpoint of 2.0 mg/L in the aeration basins to ensure adequate air is provided to biologically remove BOD and NH_3-N. This setpoint would also serve adequately for the aerobic cells when the WRF converts to the MLE process. Maintaining DO at less than 1.0 mg/L has the potential to allow poor-settling sludge to accumulate, such as filaments, which can negatively impact plant performance (Richard 2003).

The existing National Pollutant Discharge Elimination System (NPDES) Permit can be found in Appendix A, and the existing Recycled Water Permit and Fact Sheet can be found in Appendix B.

3 Aeration Equipment Evaluation

This section provides an evaluation of the different technologies used for wastewater aeration, recommendations for the electrical infrastructure upgrade associated with the secondary treatment system, and the recommended approach to blower procurement and phasing.

3.1 Blower Technology

Aeration accounts for over 50 percent of power consumption at WRFs, depending on the treatment process. As the Ketchum/SVWSD WRF aeration basins are converted to MLE process by adding an energy saving anoxic step, the proportion of total WRF power consumption related to aeration in the secondary treatment system will decrease. The energy efficient MLE process also decreases capital costs as the blower size required is smaller.

This section pulls much of the same information presented in the FPS (HDR 2022) and presents the different technologies that are commonly used for aeration in WRFs. Additional discussion, especially related to turndown potential, are added in this memorandum. Turndown is especially critical at the WRF, as the service area experiences heavy seasonal fluctuation on top of the typical diurnal flows a WRF experiences.

The estimated seasonal peak population is up to 40 percent higher (HDR 2022) than the average annual population, which likely has a large influence as to why the ratio of peak day to peak month flow is 1.35 versus the typical 1.20 (M&E 2014), or why the ratio of peak hour to peak month flow is 2.32 versus the typical 1.50 (M&E 2014). These large peaks require blowers to be sized much larger than what is needed for most of the year so turndown is essential to maintain energy efficiency.

3.1.1 Centrifugal Blowers

Multi-stage centrifugal blowers, like the blower found in the (foreground of Figure 1, have been used for wastewater aeration since near the beginning of activated sludge treatment. These blowers use multiple stages of impellers to convert rotational energy into pressure head as shown in Figure 4. These blowers typically operate with the impeller shaft direct coupled to the motor, so they run up to 3,600 revolutions per minute (RPM). Centrifugal blower energy demand is generally the basis of “energy savings” comparisons by other technologies since centrifugal blowers have been the standard aeration technology for decades. Centrifugal blowers have a typical nominal blower efficiency of 60 to 70 percent (M&E 2014).

Centrifugal blowers are equipped with surge control panels that aid in keeping the air flow within the lower and upper limits of the blower curve. Operating outside the limits creates unstable operating conditions and causes automatic shut-down. The blower output can be controlled by either VFD or control of the intake air. Centrifugal blowers have great functionality for flows and pressures as high as 10,000 SCFM and 15 PSIG.

Multi-stage centrifugal blowers generally do not turn down well. Individual units typically cannot turn down more than 2:1 due to the blower curve and surge conditions, so multiple service units need to be used to achieve higher overall turndown.

Figure 4. Typical Centrifugal Blower Cross-Section

3.1.2 Positive Displacement Blowers

Positive displacement (PD), or rotary lobe, blowers typically use bi- or tri-lobe blower configurations to push air, as seen in Figure 5. PD blowers compress air in the pockets between each lobe and deliver constant-pressure flow. Since PD blowers deliver constant pressure, air flow is directly correlated to the operating speed of the motor and the lobes.

They are simple and easier to maintain than other blower technologies but do not offer significant energy savings, with a typical nominal blower efficiency of 60 to 70 percent (M&E 2014). There are small gaps between the lobes that prevent the lobes from damaging each other from which air can escape and limit the efficiency (slippage). The lobes are often geared such that they spin at a faster rate than the motor shaft, as high as 5,000 RPM or more with a motor rated for 3,600 RPM.

PD blowers are typically used for lower flow (less than 3,000 SCFM), and medium pressure (up to 15 PSIG) applications and generally require more energy than other technologies, with a typical nominal blower efficiency of 45 to 65 percent (M&E 2014). The higher energy consumption is due to “slip”, where the compressed air leaks back into the suction side in the tiny gaps between the lobes. PD blowers have better turndown capabilities compared to multi-stage centrifugal blowers. Turndown is accomplished by either a mechanical reduction in blower speed or electrical reduction in motor speed (VFD). Individual units typically turn down from 2:1 on the low end and 4:1 on the high end, so multiple service units would need to be used to achieve higher overall turndown. However, PD blowers for this application are on the upper end of the typical airflow for consideration.

Figure 5. Typical PD blower Cross-Section

3.1.3 Hybrid Blowers

Hybrid blowers, commonly referred to as twisted tri-lobe blowers, are a specialized type of PD blower. It combines the basic lobe-style compression with the twisted rotor style of screw compressors. The twisted lobes reduce the air slipping problems associated with PD blowers, greatly increasing efficiency. This allows hybrid blowers to take advantage of constant-pressure flow with reduced energy loss. The twisted lobe cross-section can be seen in Figure 6.

Since hybrid blowers take most of its functional design from PD blowers, the lobes spin at the same rates as PD – as high as 5,000 RPM or more with a motor rated for 3,600 RPM. Hybrid blowers can handle a wide variety of airflows. Generally, this technology is used when the application needs air to be compressed between 10 to 15 PSIG. Hybrid blowers used in these pressure ranges are incredibly efficient, with a typical nominal blower efficiency of 70 to 80 percent, with maintenance ease similar to PD blowers. Activated sludge system blowers commonly require air pressures around 10 PSIG. This makes hybrid blowers a strong contender for wastewater aeration.

Hybrid blowers can typically provide up to 5,000 SCFM per unit. Turndown on hybrid blowers is typically around 3:1. Energy efficiency is typically best maintained by using multiple units to achieve a higher overall turndown.

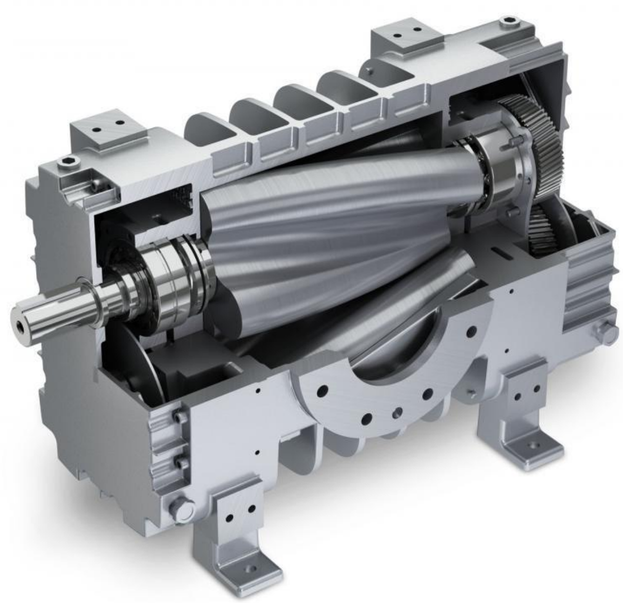


Figure 6. Typical Hybrid Blower Cross-Section

3.1.4 Turbo Blowers

Turbo blowers are the most advanced compression technology available for wastewater aeration. While the other technologies use motor shafts and bearings to turn the impellers or lobes, turbos use either the incoming air or a magnetic bearing to suspend the impeller. This allows turbos to use small impellers at incredibly high rotational speeds (often up to 24,000 RPM). This is possible because the impeller does not touch any other mechanical parts during typical operation. Turbo blowers have a typical nominal blower efficiency of 75 to 80 percent (M&E 2014).

Because turbos are so technologically advanced, it is not advised that the WRF operators perform maintenance on the equipment. There are also concerns with blower shutdowns as sacrificial bearings are used in the event that the blower loses power or is shut off. Figure 7**Error! Reference source not found.** depicts a turbo blower impeller.

Turbo blowers are the most efficient technology at pressures between 7 to 10 PSIG. They turn rotational energy into pressure head, like centrifugal blowers, and do not provide constant-pressure flow. These blowers can handle flows as high as 10,000 SCFM per unit. Turbo blowers typically have a higher cost than other types due to the advanced high-speed drives and related high precision. Selection between these two technologies depends on the system, the manufacturer, and operator preferences.

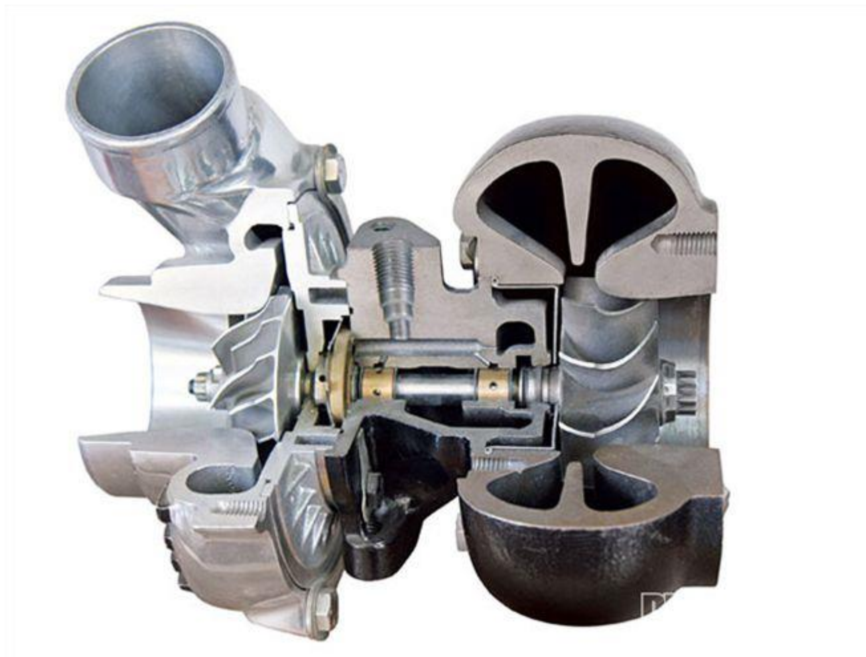


Figure 7. Typical Turbo Blower Cross-Section

3.1.5 Blower Recommendation

We recommend using the hybrid blower technology for the aeration blower and future digester blowers. This recommendation is based upon standard maintenance requirements, using same type blowers for aeration and digestion, and blower efficiency similar to turbo blowers.

The recommended layout for the aeration system blowers is to use two service hybrid blowers, with one standby unit (three total), to achieve the minimum-required 4,910 SCFM identified by the biological modeling. Using blowers capable of 2,500 SCFM per unit will provide the WRF with flexibility in operation and will be conservative for initial conditions. The preliminary differential pressure required is 7.0 PSIG and will be confirmed prior to equipment bidding.

The motor size for a hybrid blower with a duty point of 2,500 SCFM at 7.0 PSIG is 150-HP. The selected hybrid for this application has a turndown of approximately 3.4:1 at the design flow, compared to the turbo turndown of approximately 1.9:1.

3.2 Equipment Procurement

The equipment procurement approach should balance initial capital cost requirements and the construction sequence required in the Wood River Valley. Typically, projects with outside work start in May and attempt to enclose structures in the fall before winter conditions cause increased outside construction costs. Once the building is enclosed, wintertime installation of the equipment can proceed so equipment startup can begin around March or April.

The City of Ketchum and SVWSD prefer a system where the major equipment is Owner Furnished. This approach has assisted in ensuring that high-quality equipment is installed throughout the plant and allows projects to meet the expected summer construction schedule. Wastewater equipment and associated VFDs generally have a delivery time of 20 to 30 weeks from issuance of the purchase order but have been as high as 80 weeks in the last couple years due to supply chain issues related to the COVID-19 pandemic. By procuring the equipment before construction bidding commences, the equipment can arrive on-site very close to the time contractors are ready to install the equipment. This approach was last used for the WRF's Headworks Improvements project completed in 2019 and is anticipated to be used in the upcoming Aeration Basins 3 & 4 MLE Conversion project.

3.3 Equipment Sequencing

The planning approach requires two hybrid blowers to be purchased now. The first hybrid should be installed in the middle of the building, replacing the failed turbo blower. The second hybrid should be installed near the basement stairs on the south side of the building, replacing the old centrifugal unit. The centrifugal blower should not be taken offline until the first hybrid is fully operational. Once both hybrid blowers are installed and operating, the turbo on the north end will become the redundant unit as the two hybrids will be sufficiently reliable to avoid running the spare turbo.

The third hybrid blower can be installed around 2030 before it reaches the typical blower lifespan of 20 years, or sooner if it fails. The two hybrid blowers will have sufficient total capacity for aeration if the turbo blower does fail prematurely, but the WRF would fall back into a situation of missing redundancy, albeit with blower units that will be more reliable than the current situation.

Figure 8 details the air demand over the planning period compared to the total and redundant capacities of the blowers. The total capacity is the maximum air the blowers can supply with all units running, and the redundant capacity is the maximum air the blowers can supply with the largest unit out of service.

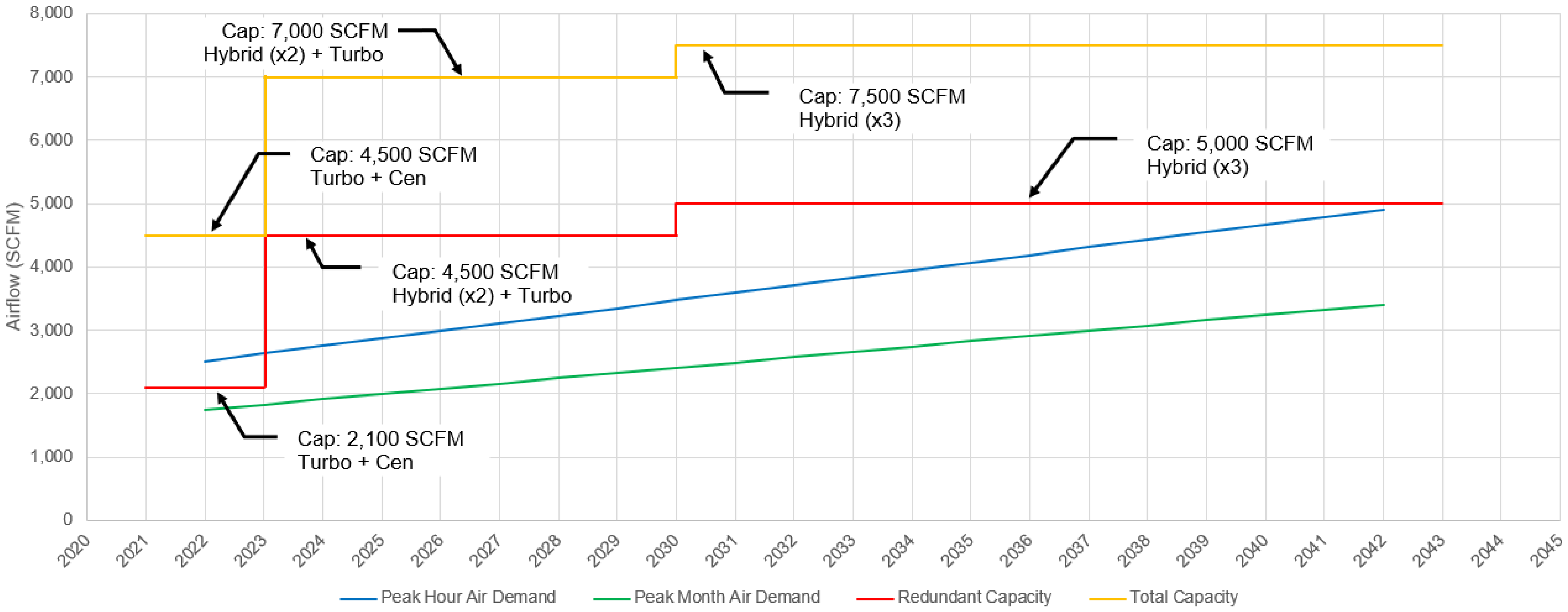


Figure 8. Air Demand versus Blower Capacity Over Time

This page is intentionally left blank.

4 Electrical Infrastructure

A new electrical room will be added on the western side of the Aeration Blower Building. This will relieve the blower room of the current space constraints and allow the electrical equipment its own dedicated room. The electrical room will house a new distribution switchboard, active harmonic filter, variable frequency drives, MCC, distribution panelboards, and SCADA panel. The electrical room will extend to the west of the building and square off the west side with the air intake room, as seen in Figure 9. This new space in the blower room will allow three hybrid blowers to be installed without expanding the Aeration Blower Building to the east towards Clarifier No. 1.

An active harmonic filter will be used instead of passive harmonic filters because; 1) it allows blower operation with the plant engine-generator, 2) it is more effective at harmonic mitigation regardless of which VFD is in operation and where each blower/pump is operating on its pump curve, 3) it is more effective at reducing electrical energy costs, and 4) passive harmonic filter failure will also incapacitate the affected motors, whereas active harmonic filter failure will not.

Power monitors (i.e., metering) will be provided in the main distribution switchboard and MCC. The power monitors and all VFDs, motor starter solid-state overload relays, active harmonic filter, and other load monitoring equipment will be connected via SCADA network to allow greater electrical system visibility, obtain power and power quality data for improved analytics and decision-making, engage in energy efficiency programs, and reduce operating costs.

The existing 1,000-amp feeder from the Operations Building electrical room switchgear is presently installed in conduit, and the conduit is routed in a concrete cable trench with aluminum lids. The cable trench presently allows exterior water to enter the buildings which needs to be mitigated. As such, the cable trench will be filled with concrete as part of this project and the aluminum lids will be removed.

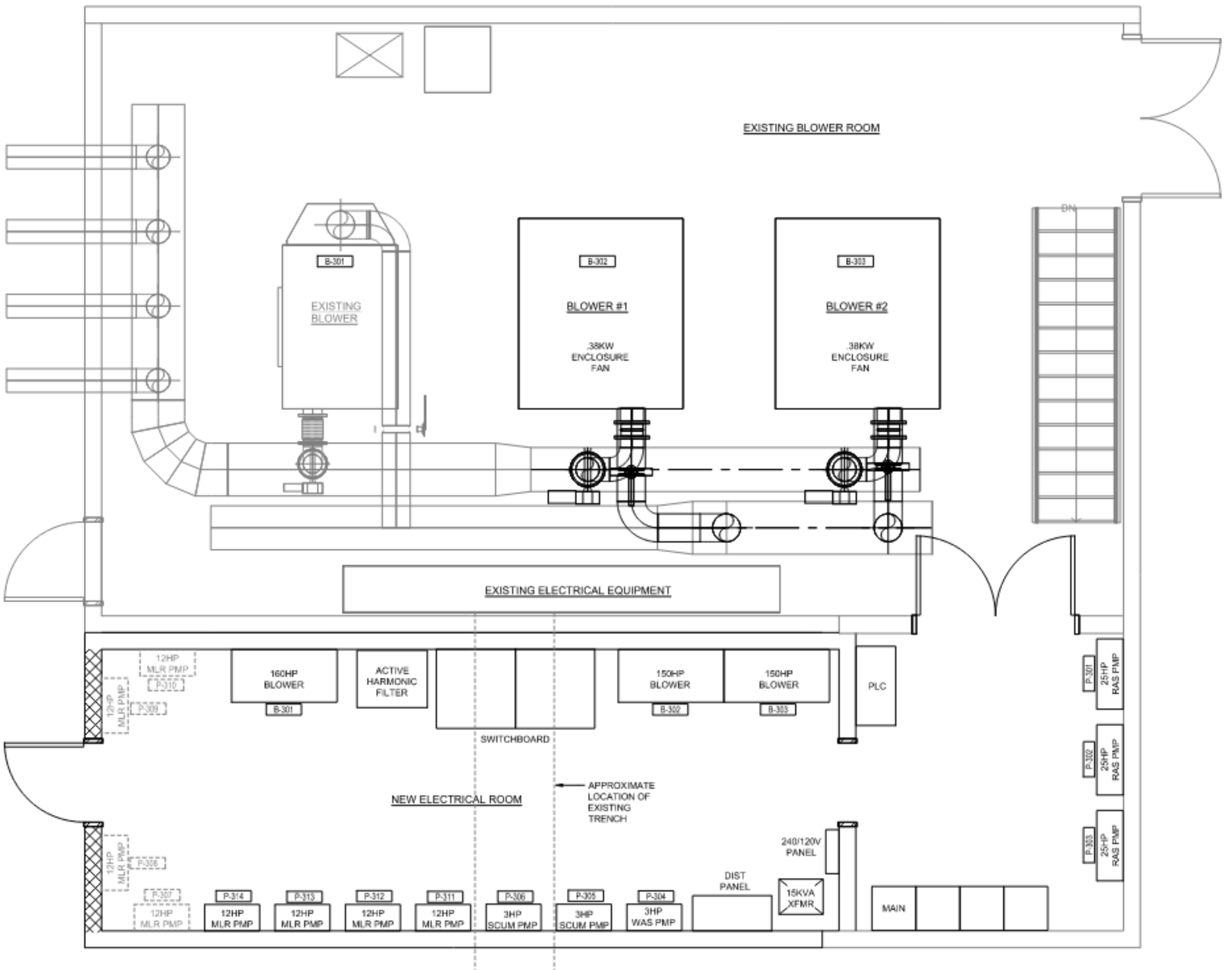


Figure 9. Preliminary Electrical Room Plan

4.1 Low-Voltage (600-V) Variable Frequency Drives

- VFDs shall be Rockwell Automation PowerFlex 750 series or equivalent with native Ethernet IP connectivity.
- Integrated VFD system complete with 480-V lockable fused disconnect switch, power/signal conditioning, control power transformer, control relays, axial fan controlled via thermostat, and door-mounted devices. Install each VFD system within its own individual enclosure.
- Conditioning: Provide 5 percent nominal reactance input reactor and 3 percent nominal reactance output reactor for power conditioning. Install all conditioning devices within the drive enclosure.
- Line terminators on motor leads longer than 150 feet.
- Enclosure shall be fan-vented with axial fan controlled via thermostat.
- Provide human-to-machine interface (HMI) mounted on the front door of the VFD enclosure.

4.2 Low-Voltage (600-V) Motor Control Centers

- Specify equipment to accommodate competitive bidding from Eaton, Allen-Bradley, or approved equivalent.
- Ethernet IP Protocol: Provide all Ethernet-connected terminal equipment specified within the MCC (i.e., metering, overload relays, etc.) with a native Ethernet IP port. Separate protocol converters and gateways used to convert from other protocols are not acceptable.
- Use MCCs primarily for motor controls. Use panelboards and switchboards to serve branch circuits and other feeders.
- Motor Controller Units: Unit elements shall be of the same manufacturer as the MCCs. Only consider variances to meet Ethernet IP protocol requirements.
- Infrared inspection ports (main breaker sections only).
- Solid-state fully programmable electronic overload relays should be capable of communications with plant SCADA via Ethernet IP. Provide with accessible user interface without opening the cubicle door.
- Tin-plated copper bus.
- Reserve a minimum 25 percent capacity (physical and electrical) on each new MCC bus for future expansion.
- Rated for the available short-circuit current at the point of connection.
- Electromechanical starters: Use motor circuit protector with size based on the specific motor supplied. Trip setting shall be adjustable from 700 to 1,300 percent of the motor full load amperes from the front of the breaker.
- Each electronic overload relay and power monitor (PMD) in the MCC shall be supplied with a means to communicate via Ethernet/IP protocol and be networked via Ethernet switch. The MCC shall have an industrial Ethernet switch and Ethernet wiring incorporated into its design for interfacing the overload relays and meter to the facility control network.

- Provide uninterruptible 120VAC power supply from SCADA panel to the MCC to power the Ethernet switch and PMD.
- Provide properly sized feeder overcurrent protection and instrument transformers for metering.

4.3 Active Harmonic Filters

- TCI Harmonic Guard or approved equivalent.
- The filter shall inject harmonic current to cancel load-produced harmonic current so the upstream power harmonic current and voltage are reduced to below 5 percent total demand distortion and 5 percent total harmonic distortion (V), respectfully. The system shall correct all types of nonlinear loads.
- Control modes:
  - Harmonic correction only
  - Power factor correction only
  - Combination harmonic and power factor
- Activate or deactivate correction of reactive current displacement power factor via a door-mounted HMI with touch screen control.
- Provide native Ethernet IP interface for remote communications. Protocol converters and gateways used to convert from other protocols are not acceptable.

4.4 Power Monitor and Display

- The power monitor and display (PMD) unit shall monitor all three phases and display volts (phase-to-phase and phase-to-neutral), amperes, power factor, frequency, harmonics, etc.
- Provide with native Ethernet IP communications port (no exceptions) for internal networking via Ethernet switch within switchgear and MCCs and to the plant control network.
- Main switchboard: Allen-Bradley PowerMonitor 5000 model M6 with integral display module or equivalent.
- Main Lug Only MCCs: Allen-Bradley PowerMonitor 500 or equivalent.
- Provide blown fuse indicators on all fuses.
- Provide current transformers with a minimum of 1 percent accuracy at 10 percent of range and all mounting hardware, including, but not limited to, shorting terminal blocks for a complete installation.
- Mount the power monitor in the unit door between 54 inches and 66 inches above the floor when installed on the housekeeping pad.
- Energize power monitors at 120-V via SCADA panel UPS circuit to the switchboard and MCC. Provide a circuit with required overcurrent protection and disconnecting means.

4.5 Low-Voltage Distribution: Panelboards and Switchboards

- Circuit breakers shall be fully rated; series-connected ratings are unacceptable.

- Circuit breaker bus connections: bolt-on circuit breakers in 480/277-V, and plug-in in 208/120 and 240/120 branch circuit panelboards.
- Use variable magnetic trip elements with single continuous adjustment 3X to 10X for frames greater than 100 amps.
- Tin-plated copper bus.
- Provide arc flash reduction maintenance system on service entrance breakers.

4.6 Electrical Equipment Loads

The new blower equipment space requirements in conjunction with outdated electrical equipment are the catalyst for a complete electrical upgrade. Table 6 outlines the preliminary equipment list to be served with the new electrical equipment that replaces MCC-2. A preliminary one-line diagram for the new MCC-2 can be found in Figure 10.

Table 6. Preliminary List of New & Upgraded Equipment for MCC-2

Equipment Name	Equipment Number	Capacity	Location	Motor Size (HP)	Voltage (V)	VFD or Constant?	New/Upgraded or Existing
Aeration Blower 01 (FUTURE)	*B-301*	*2,500 SCFM @ 7.0 PSIG*	*Aeration Blower Building*	*150*	*480V/3*	*VFD*	*Upgraded*
Aeration Blower 02	B-302	2,500 SCFM @ 7.0 PSIG	Aeration Blower Building	150	480V/3	VFD	Upgraded
Aeration Blower 03	B-303	2,500 SCFM @ 7.0 PSIG	Aeration Blower Building	150	480V/3	VFD	Upgraded
Aeration Blower Enclosure Fan 01 (FUTURE)	*F-301*		*Aeration Blower Building*	*0.38 kW*	*480V/3*	*Constant*	*New*
Aeration Blower Enclosure Fan 02	F-302		Aeration Blower Building	0.38 kW	480V/3	Constant	New
Aeration Blower Enclosure Fan 03	F-303		Aeration Blower Building	0.38 kW	480V/3	Constant	New
Exhaust Fan 01	EF-301		Aeration Blower Building	1	480V/3	Constant	Existing
Exhaust Fan 02	EF-302		Aeration Blower Building	1	480V/3	Constant	Existing
Exhaust Fan 03	EF-303		Aeration Blower Building	1/3	240V/1	Constant	Existing
Clarifier Supply Fan	SF-301		Clarifier No. 1	3/4	480V/3	Constant	Existing
Clarifier Unit Heater	UH-301		Clarifier No. 1	10 kW	480V/3	Constant	Existing
RAS Pump 01	P-301	1,560 GPM @ 36 ft TDH	Aeration Blower Building	25	480V/3	VFD	Existing
RAS Pump 02	P-302	1,560 GPM @ 36 ft TDH	Aeration Blower Building	25	480V/3	VFD	Existing
RAS Pump 03	P-303	1,560 GPM @ 36 ft TDH	Aeration Blower Building	25	480V/3	VFD	Existing
WAS Pump 01	P-304	120 GPM @ 30 PSI	Aeration Blower Building	3	480V/3	VFD	Existing
WAS Pump 02	P-305	85 GPM @ 12 ft TDH	Aeration Blower Building	3	480V/3	VFD	Existing
Scum Pump 01	P-306	85 GPM @ 12 ft TDH	Aeration Blower Building	3	480V/3	VFD	Existing
MLR Pump 01 (FUTURE)	*P-307*	*1,190 GPM @ 15.1 ft TDH*	*Aeration Basin 01*	*12*	*480V/3*	*VFD*	*New*
MLR Pump 02 (FUTURE)	*P-308*	*1,190 GPM @ 15.1 ft TDH*	*Aeration Basin 01*	*12*	*480V/3*	*VFD*	*New*
MLR Pump 03 (FUTURE)	*P-309*	*1,190 GPM @ 15.1 ft TDH*	*Aeration Basin 02*	*12*	*480V/3*	*VFD*	*New*
MLR Pump 04 (FUTURE)	*P-310*	*1,190 GPM @ 15.1 ft TDH*	*Aeration Basin 02*	*12*	*480V/3*	*VFD*	*New*
MLR Pump 05	P-311	1,190 GPM @ 15.1 ft TDH	Aeration Basin 03	12	480V/3	VFD	New
MLR Pump 06	P-312	1,190 GPM @ 15.1 ft TDH	Aeration Basin 03	12	480V/3	VFD	New
MLR Pump 07	P-313	1,190 GPM @ 15.1 ft TDH	Aeration Basin 04	12	480V/3	VFD	New
MLR Pump 08	P-314	1,190 GPM @ 15.1 ft TDH	Aeration Basin 04	12	480V/3	VFD	New
Anoxic Mixer 01 (FUTURE)	*MXR-301*		*Aeration Basin 01*	*7.5*	*480V/3*	*Constant*	*New*
Anoxic Mixer 02 (FUTURE)	*MXR-302*		*Aeration Basin 02*	*7.5*	*480V/3*	*Constant*	*New*
Anoxic Mixer 03	MXR-303		Aeration Basin 03	7.5	480V/3	Constant	New
Anoxic Mixer 04	MXR-304		Aeration Basin 04	7.5	480V/3	Constant	New
Clarifier No. 1 Mechanism	MECH-301		Clarifier No. 1	0.5	480V/3	Constant	Existing
Clarifier No. 2 Panel "EH"	MECH-302		Clarifier No. 2	1	480V/3	Constant	Existing
Panelboard LP	P-801		Alum Building	-	120V/1	Constant	Existing
Polymer Feed Pump	P-802		Aeration Blower Building	-	120V/1	Constant	Existing (wall outlet)

MSB1 - CONNECTED LOAD SUMMARY

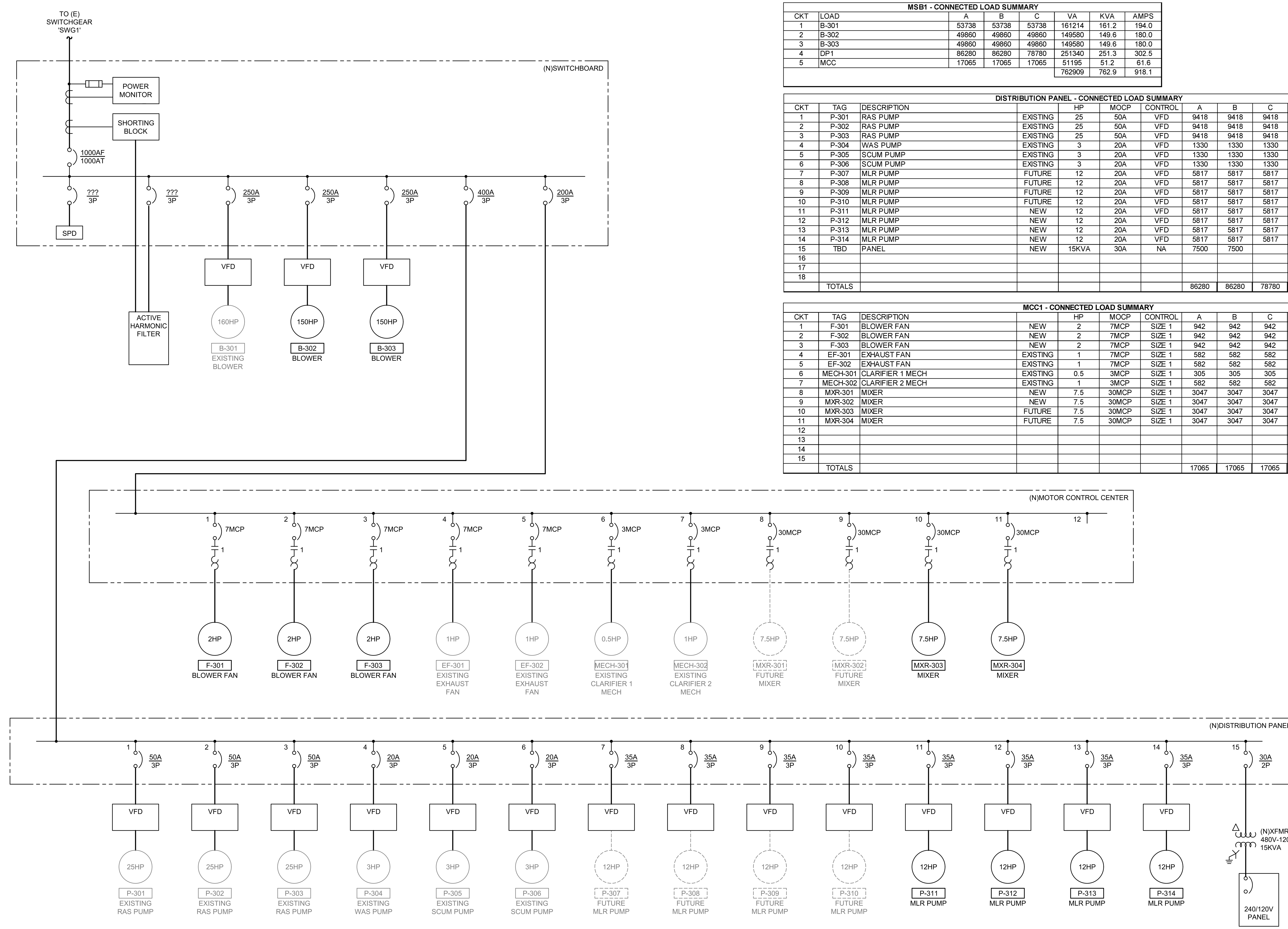
CKT	LOAD	A	B	C	VA	KVA	AMPS
1	B-301	53738	53738	53738	161214	161.2	194.0
2	B-302	49860	49860	49860	149580	149.6	180.0
3	B-303	49860	49860	49860	149580	149.6	180.0
4	DP1	86280	86280	78780	251340	251.3	302.5
5	MCC	17065	17065	17065	51195	51.2	61.6
					762909	762.9	918.1

DISTRIBUTION PANEL - CONNECTED LOAD SUMMARY

CKT	TAG	DESCRIPTION		HP	MOCP	CONTROL	A	B	C	VA	KVA	AMPS
1	P-301	RAS PUMP	EXISTING	25	50A	VFD	9418	9418	9418	28254	28.3	34.0
2	P-302	RAS PUMP	EXISTING	25	50A	VFD	9418	9418	9418	28254	28.3	34.0
3	P-303	RAS PUMP	EXISTING	25	50A	VFD	9418	9418	9418	28254	28.3	34.0
4	P-304	WAS PUMP	EXISTING	3	20A	VFD	1330	1330	1330	3990	4.0	4.8
5	P-305	SCUM PUMP	EXISTING	3	20A	VFD	1330	1330	1330	3990	4.0	4.8
6	P-306	SCUM PUMP	EXISTING	3	20A	VFD	1330	1330	1330	3990	4.0	4.8
7	P-307	MLR PUMP	FUTURE	12	20A	VFD	5817	5817	5817	17451	17.5	21.0
8	P-308	MLR PUMP	FUTURE	12	20A	VFD	5817	5817	5817	17451	17.5	21.0
9	P-309	MLR PUMP	FUTURE	12	20A	VFD	5817	5817	5817	17451	17.5	21.0
10	P-310	MLR PUMP	FUTURE	12	20A	VFD	5817	5817	5817	17451	17.5	21.0
11	P-311	MLR PUMP	NEW	12	20A	VFD	5817	5817	5817	17451	17.5	21.0
12	P-312	MLR PUMP	NEW	12	20A	VFD	5817	5817	5817	17451	17.5	21.0
13	P-313	MLR PUMP	NEW	12	20A	VFD	5817	5817	5817	17451	17.5	21.0
14	P-314	MLR PUMP	NEW	12	20A	VFD	5817	5817	5817	17451	17.5	21.0
15	TBD	PANEL	NEW	15KVA	30A	NA	7500	7500		15000	15.0	18.1
16										0	0.0	0.0
17										0	0.0	0.0
18										0	0.0	0.0
	TOTALS						86280	86280	78780	251340	251.3	302.5

MCC1 - CONNECTED LOAD SUMMARY

CKT	TAG	DESCRIPTION		HP	MOCP	CONTROL	A	B	C	VA	KVA	AMPS
1	F-301	BLOWER FAN	NEW	2	7MCP	SIZE 1	942	942	942	2826	2.8	3.4
2	F-302	BLOWER FAN	NEW	2	7MCP	SIZE 1	942	942	942	2826	2.8	3.4
3	F-303	BLOWER FAN	NEW	2	7MCP	SIZE 1	942	942	942	2826	2.8	3.4
4	EF-301	EXHAUST FAN	EXISTING	1	7MCP	SIZE 1	582	582	582	1746	1.7	2.1
5	EF-302	EXHAUST FAN	EXISTING	1	7MCP	SIZE 1	582	582	582	1746	1.7	2.1
6	MECH-301	CLARIFIER 1 MECH	EXISTING	0.5	3MCP	SIZE 1	305	305	305	915	0.9	1.1
7	MECH-302	CLARIFIER 2 MECH	EXISTING	1	3MCP	SIZE 1	582	582	582	1746	1.7	2.1
8	MXR-301	MIXER	NEW	7.5	30MCP	SIZE 1	3047	3047	3047	9141	9.1	11.0
9	MXR-302	MIXER	NEW	7.5	30MCP	SIZE 1	3047	3047	3047	9141	9.1	11.0
10	MXR-303	MIXER	FUTURE	7.5	30MCP	SIZE 1	3047	3047	3047	9141	9.1	11.0
11	MXR-304	MIXER	FUTURE	7.5	30MCP	SIZE 1	3047	3047	3047	9141	9.1	11.0
12										0	0.0	0.0
13										0	0.0	0.0
14										0	0.0	0.0
15										0	0.0	0.0
	TOTALS						17065	17065	17065	51195	51.2	61.6



PROJECT MANAGER	B. BJERKE
DESIGN BY	B. BJERKE
DRAWN BY	E. SJOBERG
CHECKED BY	P. URSILLO
PROJECT NUMBER	000000010147035

ISSUE DATE DESCRIPTION

KETCHUM/SVWSD
BLOWER BUILDING
IMPROVEMENTS

FIGURE 10. PRELIMINARY ONE-LINE DIAGRAM FOR MCC-2

FILENAME E-101.dwg
SCALE N.T.S.
SHEET E-102

This page is intentionally left blank.

5 Site Evaluation

The replacement of the aeration basin blowers and the secondary treatment electrical systems require modifications to the Aeration Blower Building that will slightly modify its footprint. The modifications will allow the new equipment to fit in the available space without increasing the blower room size.

5.1 Existing Facilities

The existing Aeration Blower Building was originally constructed in 1984 when the WRF replaced the mechanical aerators in Aeration Basins 1 & 2 with diffusers. The building structure is in good condition but will require modifications to accommodate the new equipment. The Aeration Blower Building will require a new electrical room added to the western portion of the building to house the new and existing electrical equipment.

5.2 Constraints

The existing Aeration Blower Building is currently space constrained. Modifications to the building will be necessary to accommodate the future blowers and upgraded MCC-2. Feeder 1 serves MCC-2 and provides up to 1,000 amps for the secondary treatment system equipment and will be adequate to accommodate the upgrades.

5.3 WRF Modifications

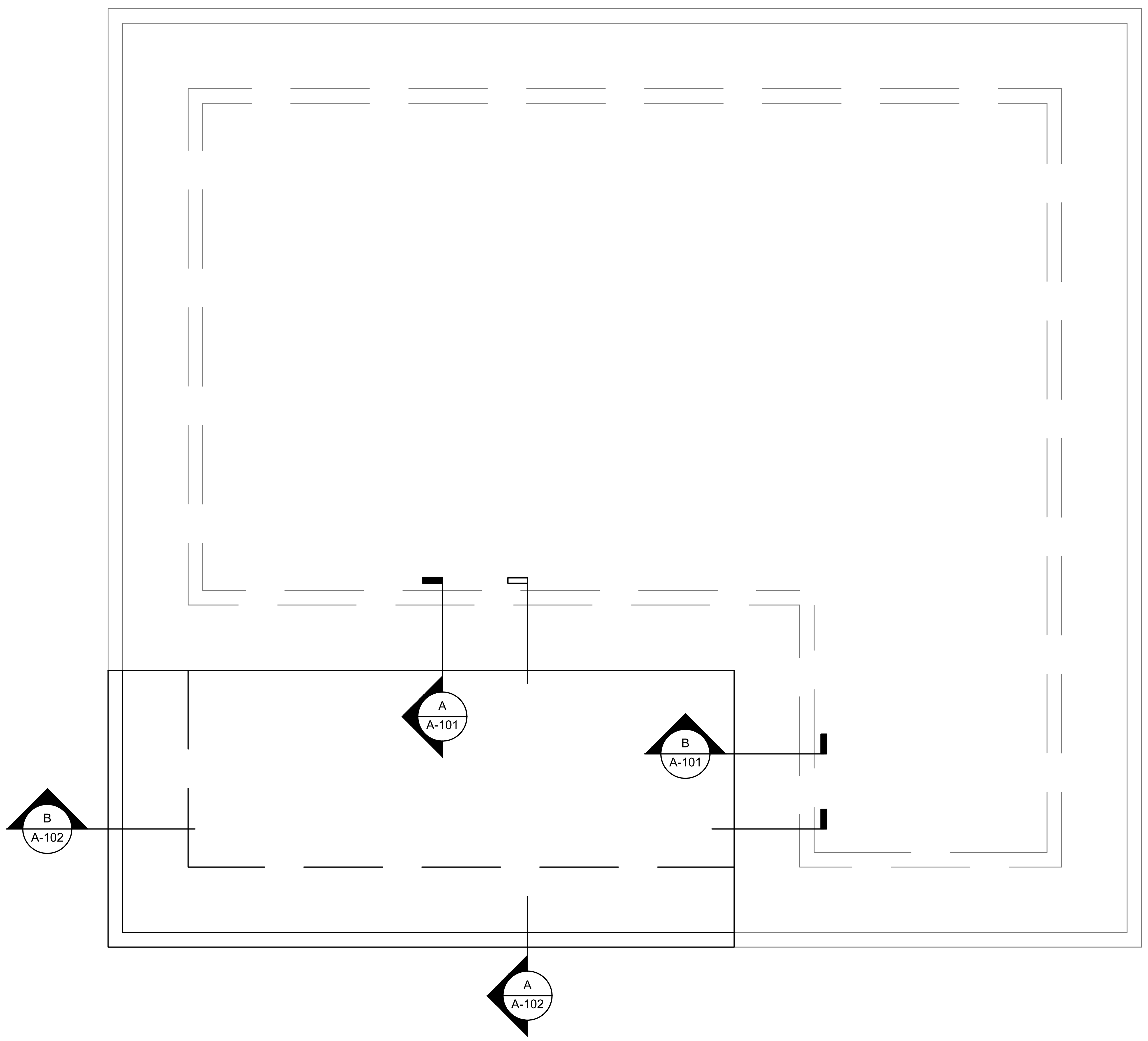
5.3.1 Blower Building Modifications

The building EIFS and parapet system on the west side will be removed for the new electrical room addition. The electrical room will have walls constructed up against the existing walls. The electrical room interior dimensions will be 10’-8” x 27’-4” for the building extension area and 10’-8 x 11’-4” for the existing air intake area. The single door in the middle of the north wall will be 3’-0” wide x 8’-0” tall. The interior opening between the new electrical room and the old air intake room will be 3’-0” wide and 11’-10” tall (open uses the louver space). The building exterior will match the existing building EIFS with a similar 3-foot overhang and parapet system.

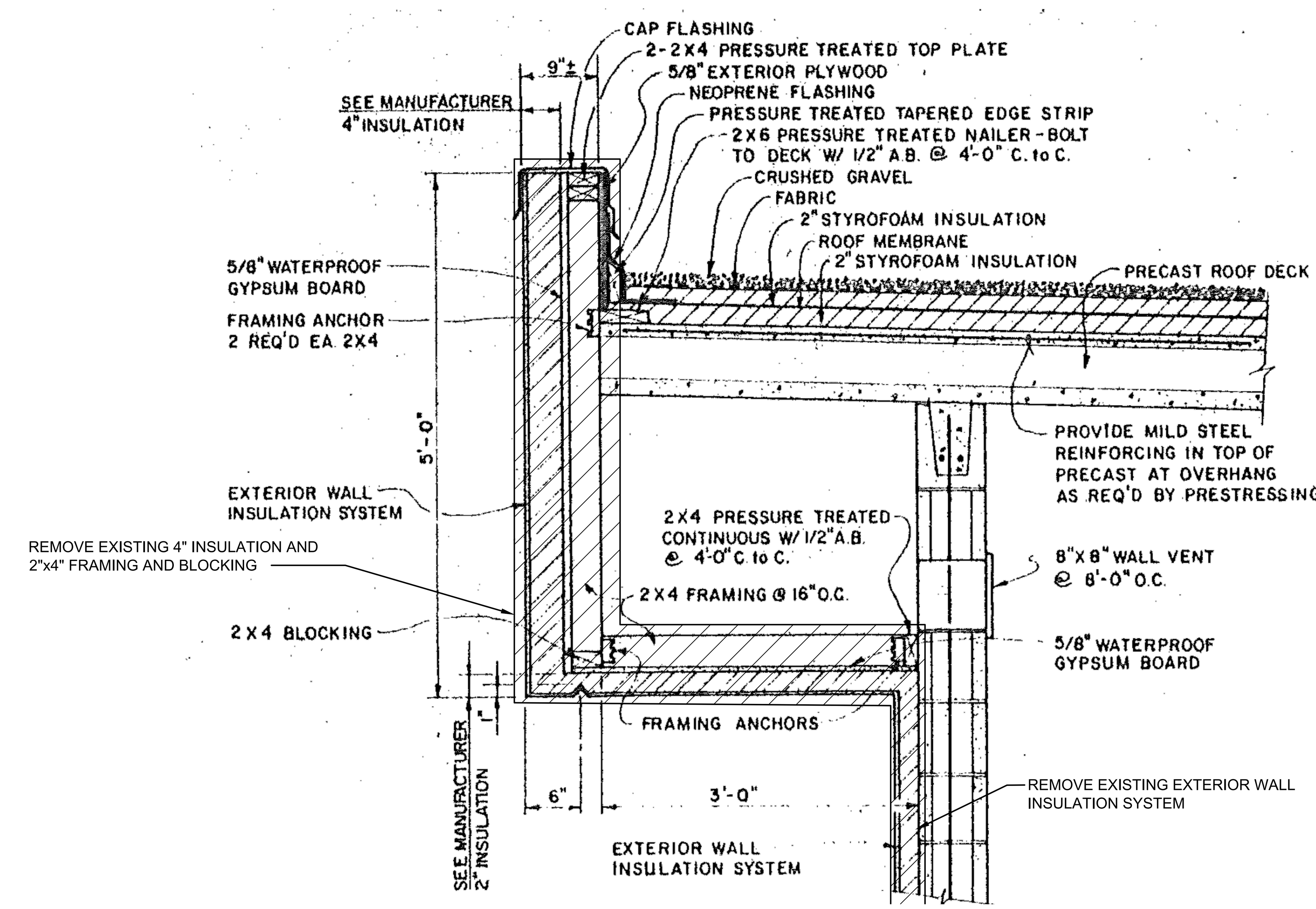
The preliminary plan and sections for the roof modifications are found in Figure 11. The preliminary plan and section for the new electrical room are found in Figure 12.

.

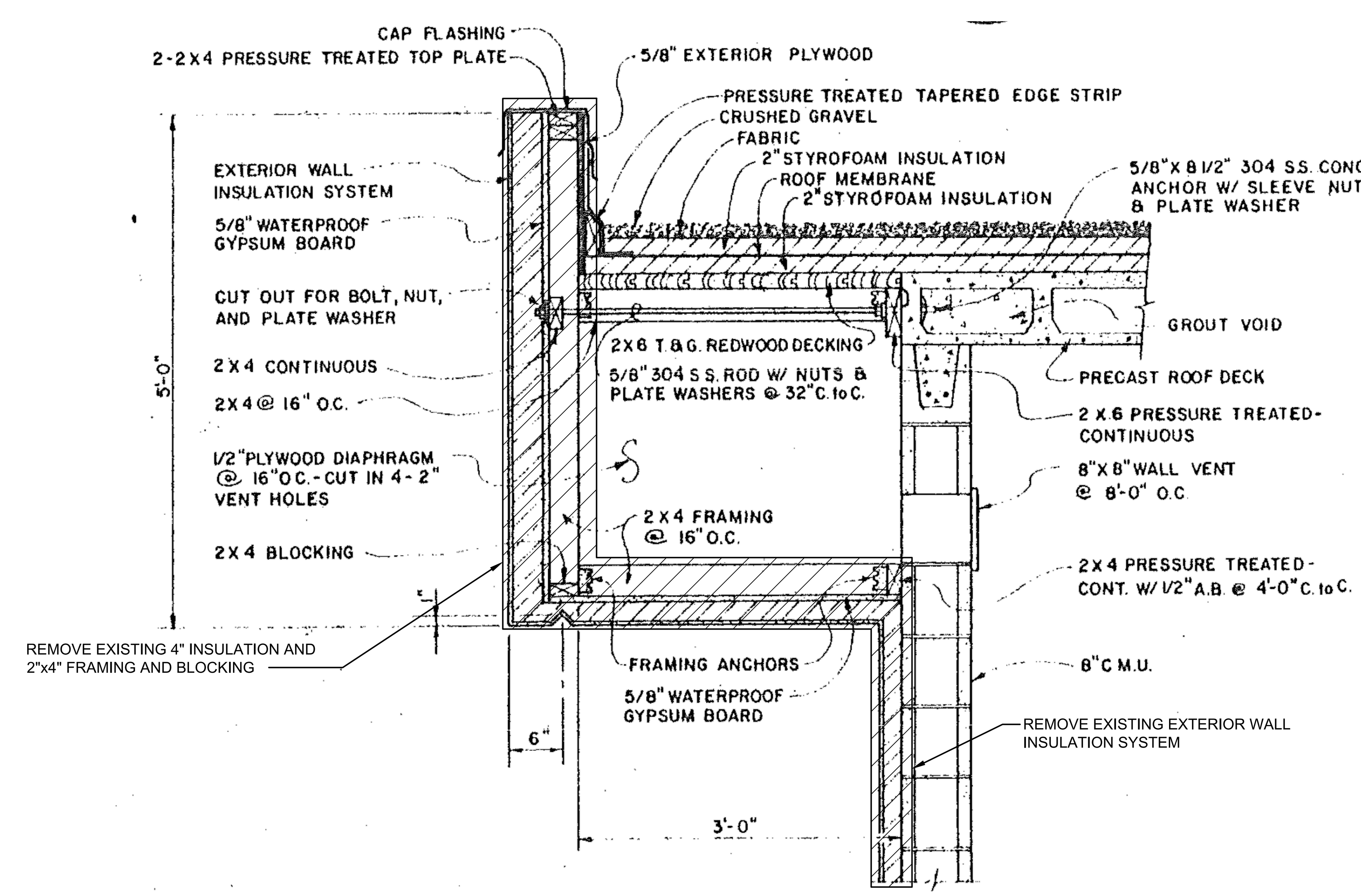
1 2 3 4 5 6 7 8



1 / A101 DEMOLITION ROOF PLAN
1/4"=1'-0"



A / A101 DEMOLITION ROOF DETAIL
NOT TO SCALE



B / A101 DEMOLITION ROOF DETAIL
NOT TO SCALE

D C B A

ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	
DESIGN BY	B. BJERKE
DRAWN BY	E. SJOBERG
CHECKED BY	P. URSILLO
	E. SJOBERG
PROJECT NUMBER	000000010147035

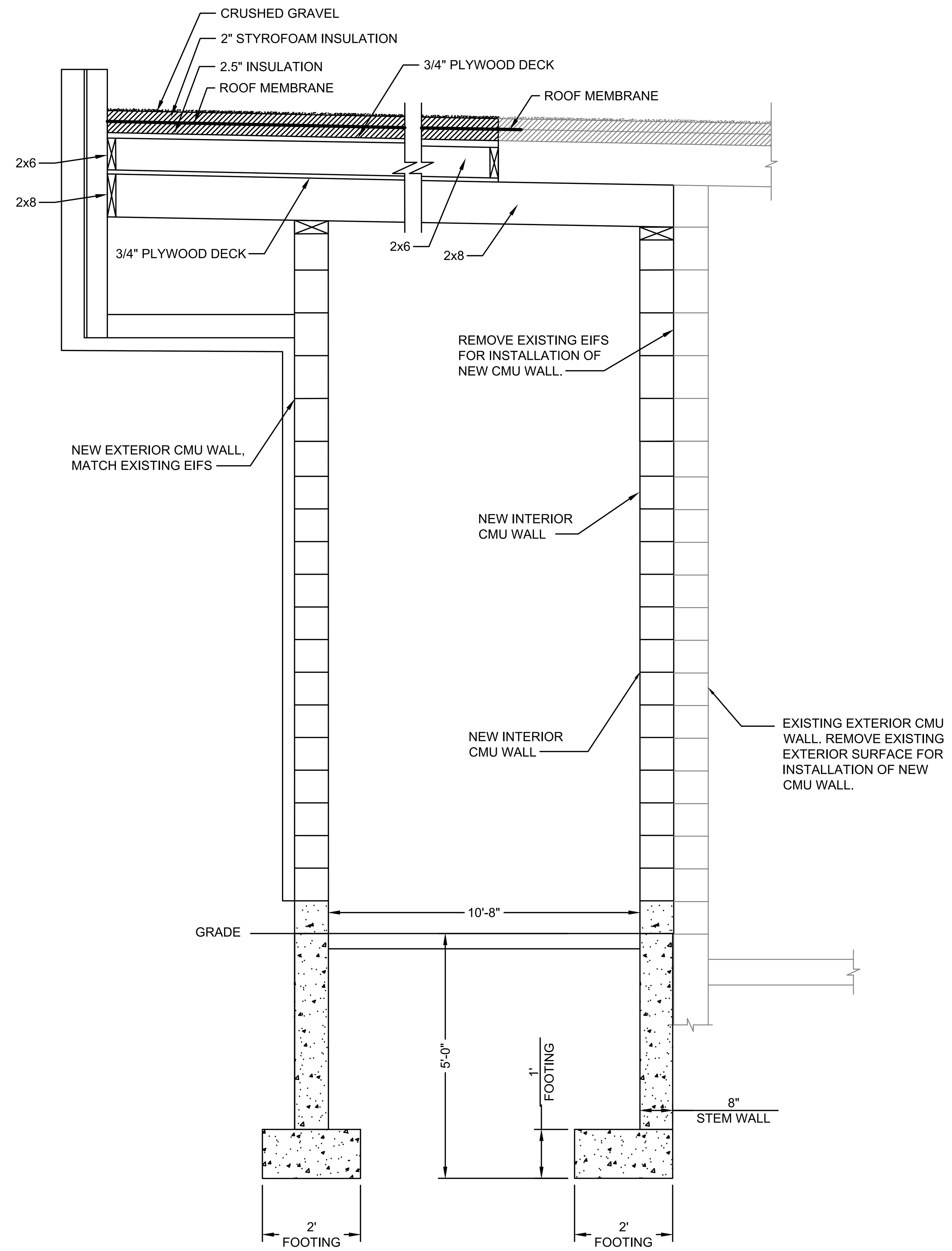
KETCHUM/SVWSD
BLOWER BUILDING
IMPROVEMENTS

FIGURE 11. PRELIMINARY BLOWER BUILDING ROOF MODIFICATION PLAN AND SECTIONS

0 1" 2"

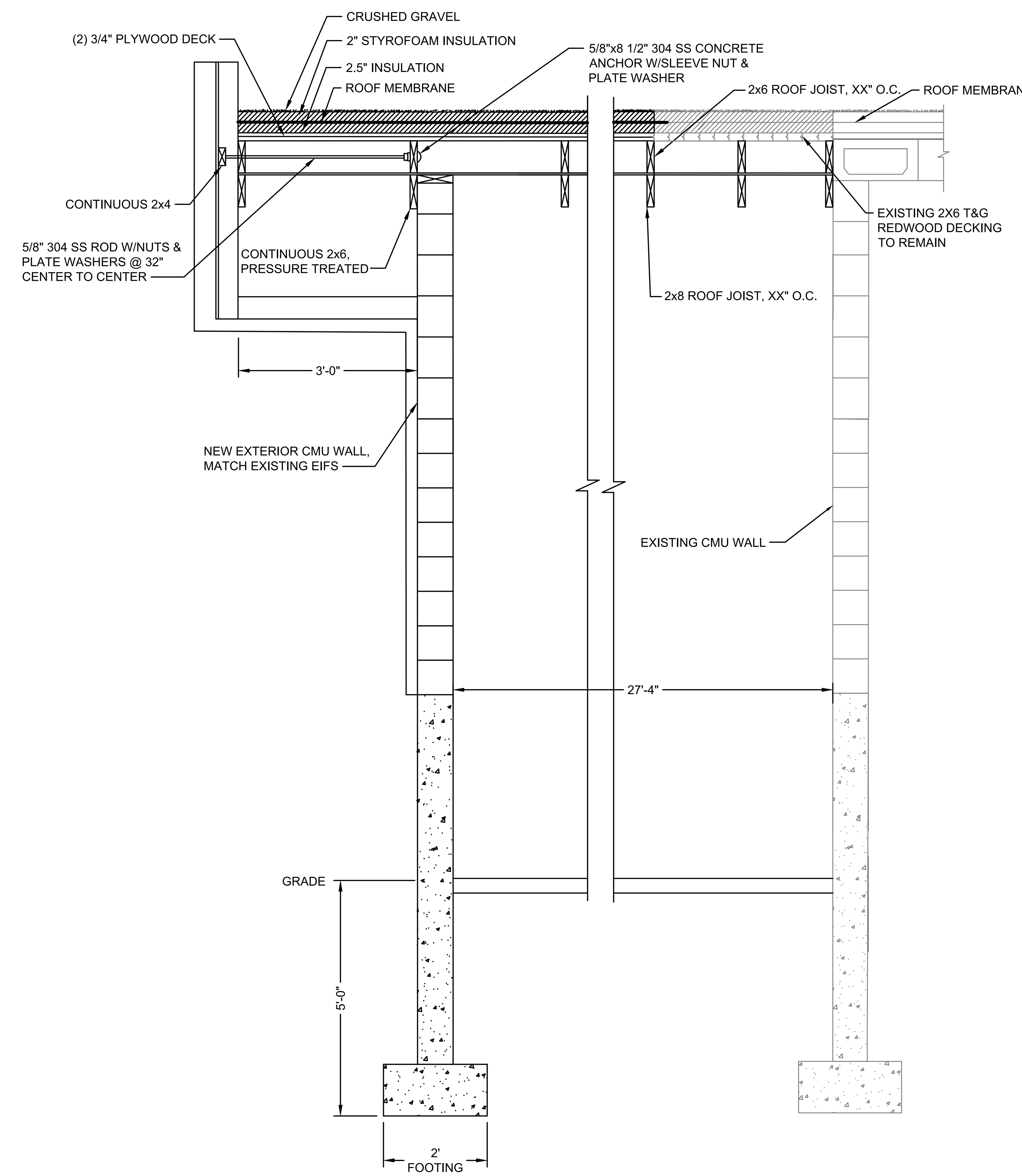
FILENAME 00D-BP01-24.dwg
SCALE NONE

SHEET A-101



A / A101 WALL SECTION

NTS



B / A101 WALL SECTION

NTS

PROJECT MANAGER	BRAD BJERKE
DESIGN BY	B. BJERKE
DRAWN BY	E. SJOBERG
CHECKED BY	P. URSILLO
	E. SJOBERG
PROJECT NUMBER	000000010147035

ISSUE DATE DESCRIPTION

KETCHUM/SVWSD
BLOWER BUILDING
IMPROVEMENTS

FIGURE 12. PRELIMINARY ELECTRICAL ROOM ADDITION PLAN AND SECTION

0 1" 2"

FILENAME 00D-BP01-24.dwg

SCALE NONE

SHEET A-102

5.3.2 Mechanical Modifications

A new heating, ventilation, and air-conditioning (HVAC) system will be added for the new electrical rooms. The existing air intake room will be converted into an electrical room extension, with an opening in the walls between the building extension and the existing room. The existing intake plenum will be replaced with canister-type air intakes that are installed outside of the building. A minimum of two canister-type intakes should be installed so that the blower system does not need to be taken offline when cleaning or replacing filter elements.

The new blowers have a different orientation than the old blowers. Inlet and discharge air pipes from the new blowers are on the west side and will need to tap into the main air intake and blower discharge headers.

New yard piping will not need to be installed for service to each aeration basin. The existing pipes are 12-inch 304 stainless steel. Each run of 12-inch air piping has a capacity of approximately 3,000 SCFM before the differential pressure requirement exceeds 7.5 PSIG. This limitation is based on power consumption costs compared to construction costs of replacing the piping. Compressing air at higher pressures can become exponentially more expensive per cubic foot of air delivered due to more expensive blower units and increased power draw. The modeling indicates that 4,910 SCFM is required to satisfy the 2042 peak hour air demand (approximately 1,640 SCFM per basin with one offline), so the pipes will not need to be upgraded within the planning period.

A preliminary isometric plan of the blower equipment and building modifications can be seen in Figure 13.

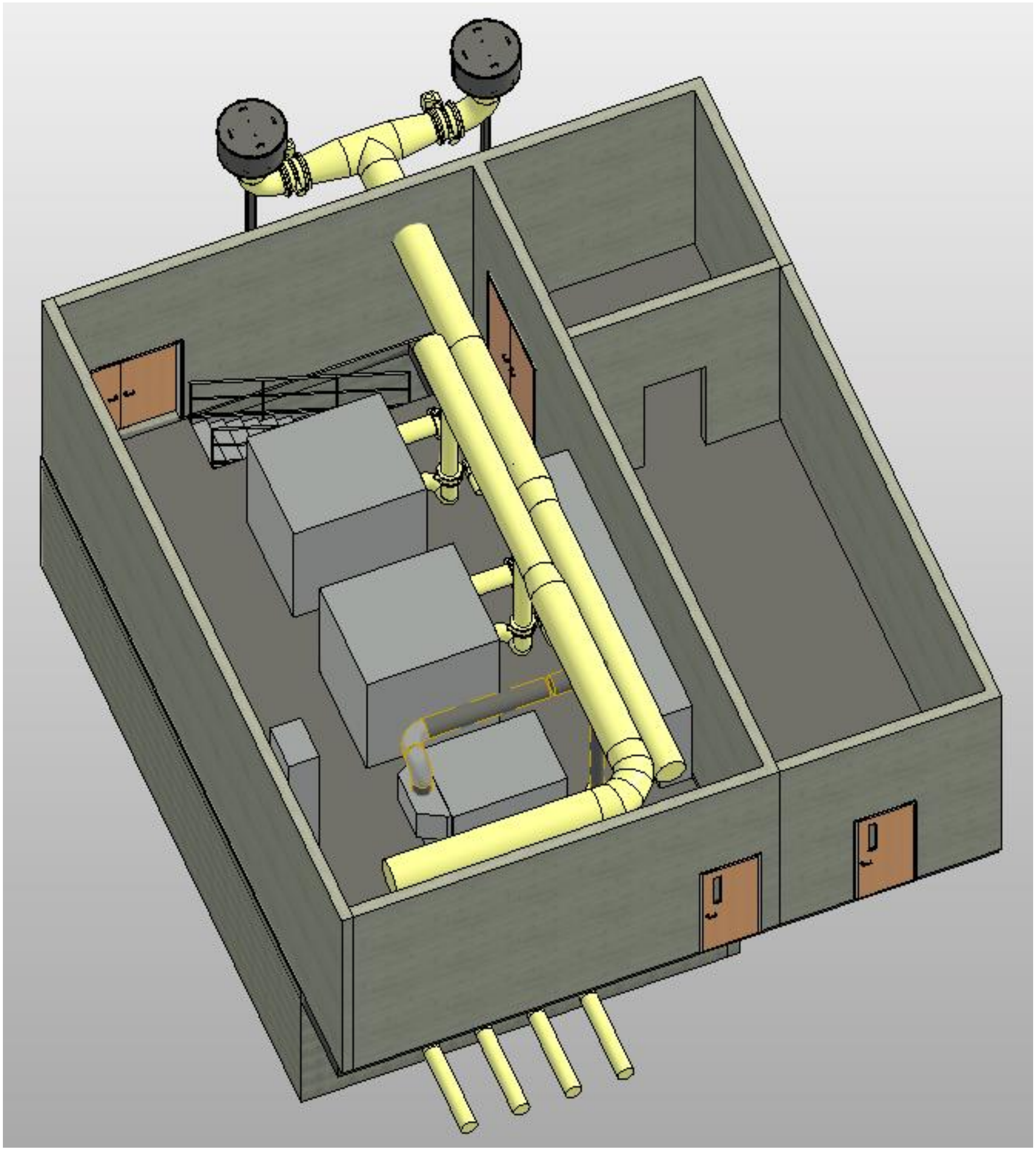


Figure 13. Preliminary Blower Building Isometric

5.3.3 Electrical Cutover During Construction

The continued operation of wastewater processes while maintaining specific effluent limits during construction and electrical cutovers is an important design consideration. Below is a possible cutover scenario to accomplish this goal:

- The new electrical room allows the installation of new distribution and motor control gear prior to de-energizing existing MCC-2.
- The existing 1,000-amp feeder from the Operations Building electrical room switchgear presently enters the Aeration Blower Building from the west side to feed MCC-2, and the new electrical room will be placed directly over the existing 1,000-amp feeder.
- The new distribution switchboard can be place over the feeder, and the feeder can be re-routed to the new switchboard.
- This will require a temporary outage to MCC-2 to make the cutover, and a temporary mobile engine-generator can be used to maintain aeration and pumping while the cutover occurs.
- Once the cutover to the new switchboard is complete, MCC-2 can then be temporarily served via the new switchboard during the construction period. This will facilitate cutovers of individual loads to the new electrical equipment as each gets installed.
- MCC-2 can be removed once all loads are cutover to the new electrical room equipment.

5.4 Treatment During Blower Construction

As described in Section 3.3, the phasing approach should be to install two hybrid blowers now. The first hybrid should be installed in the center blower space, replacing the failed turbo blower. The second hybrid blower should be installed near the basement stairs on the south side of the building, replacing the centrifugal unit. The centrifugal blower should not be taken offline until the first hybrid is fully operational. It may be necessary to take the aeration system offline to modify the blower inlet and discharge drops from the headers. If this is the case, the aeration system will need to be taken offline to successfully complete this work. It is recommended that pipe modifications to the suction and discharge headers occur during low-flow events during the night to minimize disruption to the treatment system.

The third hybrid blower will need to be installed around 2030 as the peak month air capacity begins to approach the redundant capacity of the two hybrids with the remaining turbo blower serving as a backup unit.

In order to modify the suction header intake from the current air intake room to an external canister-type inlet filter system, the aeration system will need to be taken offline to complete the work. Aeration is critical to effective treatment, so these modifications will need to occur during low-flow conditions (i.e., during the night). As much set-up work as possible should be done prior to taking the aeration system offline to minimize the time that the system is not running. This includes, but is not limited to:

- Create penetration through southern wall of blower building for 24-inch suction pipe.
- Install piping from wall penetration to the external canister-type inlet filters.

5.5 Structural Requirements and Architectural Considerations

The building electrical room addition and conversion of the air intake room to electrical room requires:

- Removal of the EIFS system,
- Installation on new CMU block walls,
- Installation of a room roof members under the existing precast,
- Addition of roofing layers to match the existing roof elevation,
- Construction of the architectural feature with the roof parapet,
- Installation of new EIFS on the new electrical room. The building EIFS has not been modified since its construction in 1984, so it may be necessary to remove and replace all the existing EIFS on the building,
- Cutting a doorway into the north air intake room wall (in place of louver),
- Filling in the west and south air intake room louvers and cover with EIFS,
- Installation of a round 24-inch opening in the south building wall for the new air inlet,
- Column support of the new intake filter assembly.

6 Implementation

6.1 Project Cost Evaluation

The preliminary engineering Opinion of Probable Construction Cost (OPCC) for the Aeration Blowers 01 & 02 and MCC-2 installation project is outlined in Table 7. The costs are developed from broad-level planning with some evaluation of site-specific criteria. The FPS cost estimates were considered “order-of-magnitude” estimates, or a Class 4 estimate (AACE 2020), as the project definition through the FPS is typically considered up to 10 percent. The FPS estimates has an anticipated range of plus 40 percent and minus 20 percent. Technical Memorandums of this scale are generally considered to be approximately 30 percent project definition, like a Predesign or Preliminary Engineering Report (PER). Estimates at 30 percent project definition are generally considered to be Class 3 estimates, which have anticipated ranges of plus 30 percent and minus 15 percent.

Unit costs shown in the tables are based on a combination of previous project experiences, vendor quotes, and HDR’s experience with material procurement in the recent months.

Table 7. OPCC Summary – Blowers 01 & 02 and MCC-2 Installation

Line Item	Quantity	Unit Price	Total[1]
Aeration Basin Blowers	2	$180,000	$360,000
Air Piping	1	LS	$204,220
Electrical Room – Structural, Architectural, Mechanical	1	LS	$248,220
Electrical Components	1	LS	$847,000
		Subtotal	$1,660,040
Contingency	%	20%	$332,010
		Subtotal	$1,992,050
Contractor’s OH & Profit	%	30%	$597,620
Sales Tax[2]	%	6%	$97,920
		Total[3]	**$2,687,590**
		Expected Upper Limit (+30%)	$3,493,870
		Expected Lower Limit (-15%)	$2,284,450

[1] Costs are shown in 2023 dollars and are not escalated to the year of procurement and construction.
[2] Contractor’s overhead and profit includes sales tax on real property that is not Owner Furnished.
[3] The total shown is accurate with a range of +30% and -15% of the value shown per AACE Class 3 estimate.
LS = lump sump; OH = overhead

The projected cost for the Blower 01 and MCC-2, and Blower 02 installation projects, which fell under the 2023 and 2025 implementation lines identified in Table 7-4 of the FPS (HDR 2022) was $2.122 million and $1.693 million (each in 2022 dollars), respectively. This means that the work identified in the FPS that aligns with this TM was projected to cost $3.815 million with an accuracy range of plus 40 percent and minus 20 percent (cost range from $3.052 million to $5.341 million).

The OPCC for the work described in this TM is $2.688 million (equivalent to $2.524 million in 2022 dollars with a January 2023 inflation rate of 6.5 percent [Statista 2023]), which is approximately one-third less than the original cost projection. Major contributors to the cost reduction in this estimate from the FPS estimates includes smaller blowers for lower air requirement and a smaller building expansion.

6.2 Implementation Plan

The implementation schedule to complete the Aeration Basin Blower & Updated Electrical project presents the schedule for the Blowers 01 & 02 and MCC-2 installation project. The schedule will be driven by equipment delivery and construction season. Since the Wood River Valley experiences heavy snowfall during the winter, construction activities typically cannot begin until April and all exterior construction should be completed by October. The interior work can continue through the winter. The current implementation plan is to issue blower and blower VFD procurement documents, followed by detailed design, and then followed with staged construction. The detailed breakdown is shown below.

Task	Initiation	Completion
Bidding Blower Owner Furnished Equipment (OFE)	March 2023	May 2023
Detailed Building Structural Design	April 2023	June 2023
Detailed Piping and Electrical Design	April 2023	September 2023
Bidding of Electrical OFE	May 2023	June 2023
Bid Electrical Room Structural Construction	June 2023	July 2023
Electrical Room Structural Construction	July 2023	November 2023
Blower Delivery	June 2023	January 2024
Bid Piping and Electrical Construction	October 2023	December 2023
Electrical Delivery (VFD, etc.)	July 2023	June 2024
Blower, Piping and Electrical Construction	January 2024	December 2024
Blower and Piping Installation	May 2024	August 2024
Finish Electrical Cutover Construction	June 2024	December 2024
Finish Building EIFS Construction	May 2024	August 2024

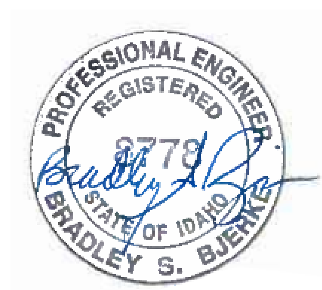
Aeration Basins 3 & 4 Modified Ludzack-Ettinger (MLE) Conversion

Technical Memorandum

City of Ketchum & Sun Valley Water and Sewer District Water Reclamation Facility

Ketchum, Idaho

March 20, 2023



03/20/2023

Contents

1 Introduction 1
 1.1 Coordination with Facility Plan 1
2 Aeration Basin Design Criteria 2
 2.1 Existing Conditions 3
  2.1.1 Existing Diffusers 3
  2.1.2 Existing Basin Structure 3
 2.2 Biological Modeling 4
  2.2.1 Biological Modeling Update 4
 2.3 Treatment Requirements 5
  2.3.1 NPDES/IPDES Permit 5
  2.3.2 Recycled Water Permit 6
3 MLE Equipment Evaluation 8
 3.1 Anoxic Zone Mixer 8
  3.1.1 Mixer Technology Recommendation 10
 3.2 Mixed Liquor Return Pump 10
 3.3 Equipment Procurement 12
 3.4 Equipment Phasing 12
4 Electrical and Controls 13
5 Site Evaluation 14
 5.1 Existing Facilities 14
 5.2 Electrical Constraints 14
 5.3 WRF Modifications 14
  5.3.1 Aeration Basin Modifications 14
 5.4 Treatment During Construction 18
6 Cost Summary 19
 6.1 Aeration Basins 3 & 4 Conversion 19
7 MLE Implementation Plan 21
8 References 22

Tables

Table 1. Planning Period Design Flows from FPS 2
Table 2. Planning Period Design Loads from FPS 2
Table 3. Current NPDES Permit Limitations 5
Table 4. Current Recycled Water Permit Limitations 6
Table 5. Air Requirements in Zones 2 and 3 with Increased Flow 15
Table 6. OPCC Summary – Aeration Basins 3 & 4 Conversion 19

Figures

Figure 1. Example of a Submersible Banana Blade Mixer 9
Figure 2. Example of a Floating Mixer 9
Figure 3. MLR Flow Schematic 11
Figure 4. Preliminary Aeration Basin 3 & 4 Isometric 12
Figure 5. Site Plan for MLE Conversion Modifications 16

Appendices

Appendix A. NDPES Permit
Appendix B. Recycled Water Permit and Fact Sheet
Appendix C. 10-Year Capital Improvement Plan
Appendix D. Aeration Basins 3 & 4 Diffuser Drawings
Appendix E. Aqua-Aerobic AquaDDM® Mixer Cut Sheets
Appendix F. Sulzer Submersible Pump Cut Sheets

Acronyms

AAF	Average annual flow
BOD	Biochemical oxygen demand
CFU	Colony-forming unit
CFU/d	Colony-forming units per day
F:M	Food-to-microorganism ratio
FPS	Facility Planning Study
HP	Horsepower
HVAC	Heating, ventilation, and air-conditioning
IDEQ	Idaho Department of Environmental Quality
IPDES	Idaho Pollutant Discharge Elimination System
Ketchum	City of Ketchum
lb/d	Pounds per day
MCC	Motor control center
MG	Million gallons
mg*min/L	Milligram-minute per liter
mg/L	Milligrams per liter
mL	Milliliter
MLE	Modified Ludzack-Ettinger
MLR	Mixed liquor return
MLSS	Mixed liquor suspended solids
NH_3-N	Ammonia-nitrogen
NO_X-N	Nitrite-plus-nitrate-nitrogen
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
PLC	Programmable logic controller
s.u.	Standard units
SCFM	Standard cubic feet per minute
SRT	Sludge retention time
SVWSD	Sun Valley Water and Sewer District
TKN	Total Kjeldahl nitrogen
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
U.S. EPA	United States Environmental Protection Agency
UV	Ultraviolet
VFD	Variable frequency drive
WRF	Water Reclamation Facility
µg/L	Micrograms per liter

This page is intentionally left blank.

1 Introduction

The City of Ketchum's (Ketchum) and Sun Valley Water and Sewer District's (SVWSD) jointly owned Ketchum / SVWSD Water Reclamation Facility (WRF) is an extended aeration activated sludge process that consists of screening, grit removal, aeration basins, secondary clarification, filtration, and ultraviolet (UV) disinfection. The solids handling facilities include an aerobic digester and solids gravity thickener.

The Facility Planning Study (FPS) completed in 2022 (HDR 2022) identified upgrades needed at the WRF through year 2042. The near-term improvements identified for 2023 through 2027 included:

- Aeration blower replacement and blower building electrical upgrades,
- Aeration Basins (AB) 3 & 4 conversion from plug-flow complete aeration to the Modified Ludzack-Ettinger (MLE) process,
- Solids thickening and dewatering facilities, and
- AB #1 & #2 upgrades creating three zones in each train, replacing diffusers and air lines, and MLE improvements.

This Technical Memorandum (TM) provides details for the conversion of activated sludge process in Aeration Basins #3 and #4 to the MLE process. The MLE process improves denitrification, a biological process which converts nitrate-nitrogen to nitrogen gas and reduces the activated sludge blower air requirement.

1.1 Coordination with Facility Plan

The FPS identified Aeration Basins 3 & 4 conversion to the MLE process as the first step in the activated sludge upgrades. The MLE conversion for AB #3 and #4 requires replacement of Zone 1 diffuser, installing mixing (instead of aeration) in Zone 1, and using recycle pumps in Zone 3 (recycling mixed liquor to Zone 1).

The MLE process consists of converting the first cell or zone in each train to an anoxic zone for denitrification. The next two cells continue to be aerated using the existing fine bubble diffusers. The anoxic zone of each basin will be mixed by either a floating or submersible mixer to keep the MLSS suspended. The final zone in each train will be equipped with mixed liquor recycle (MLR) pumps to recycle nitrate-rich wastewater back to the first zone, the anoxic cell.

AB #1 & #2, on the other hand, were constructed in 1968 and will need significant structural modifications to insert divider walls to create aeration zones similar to AB #3 and #4. The capacity need for AB #1 and #2 to meet effluent limits occurs by 2029. The conversion for Aeration Basins 1 & 2 will mirror Aeration Basins 3 & 4, but additional steps will be required to achieve the conversion in the aged basins. The basins will need to have divider walls installed to create the plug-flow arrangement needed for the MLE conversion. These divider walls, along with a catwalk with canopy, will also help to stabilize the existing center wall. The diffusers in each zone of the old basins will be replaced based on the new diffuser arrangement.

2 Aeration Basin Design Criteria

This section describes the current conditions and reviews the biological modeling and MLR sizing. The current design for AB 3 & 4 creates a three-zone plug-flow regime with all zones aerobic. Each basin contains approximately 0.5 million gallons (MG) of reactor volume, divided into three evenly sized cells to create the plug-flow arrangement. The original design used a food-to-microorganism ratio (F:M) of 0.10 pounds of biochemical oxygen demand (BOD) per pound of mixed liquor suspended solids (MLSS) per day (lb BOD/lb MLSS/d) with a design minimum sludge retention time (SRT) of 10 to 20 days (HDR 2022). The WRF operators have found a design max month MLSS concentration of 6,000 milligrams per liter (mg/L) is a suitable operational ceiling for the activated sludge process.

Table 1 presents the 2021 design flows identified in the FPS, the current 2022 design flows, and the 20-year planning period (2042) design flows projected in the FPS. The FPS projected a flow increase of approximately 2.5 percent per year based on average annual flow (AAF). The AAF increased by approximately 3.8 percent from 2021 to 2022. However, the AAF decreased by approximately 3.8 percent from 2020 to 2021. It can be assumed that annual flow increases will trend closer to the projected 2.5 percent in the upcoming years.

Table 1. Planning Period Design Flows from FPS

Parameter	FPS (2021)	Current (2022)[1]	Planning Period (2042)
Average Annual (MGD)	1.05	1.09	1.73
Peak Month (MGD)	1.34	1.11	2.57
Peak Day (MGD)	1.49	2.17	3.47
Peak Hour (MGD)	3.05	3.16	5.96

[1] Data used through December 5, 2022.
MGD = million gallons per day

Table 2 presents the 2021 design loads identified in the FPS, the current 2022 design loads, and the 20-year planning period (2042) design loads projected in the FPS.

Table 2. Planning Period Design Loads from FPS

Parameter	Average Annual			Peak Month		
	FPS (2021)	Current (2022)	Planning Period (2042)	FPS (2021)	Current (2022)	Planning Period (2042)
BOD (lb/d)	2,348	2,764	3,890	3,857	4,052	5,760
TSS (lb/d)	1,715	1,523	2,900	2,345	2,293	4,300
TP (lb/d)[1]	34	32	58	44	45	86
TKN (lb/d)[2]	351	294	580	446	401	860

[1] TP analysis problems overestimated TP load from February 22, 2022 through March 15, 2022. This data was not used.
[2] Data based on typical WRF influent concentration of 40 mg/L for FPS (2021) and Planning Period (2042) data (M&E 2014). Actual operating data used for Current (2022).
BOD = biochemical oxygen demand; TSS = total suspended solids; TP = total phosphorus; TKN = total Kjeldahl nitrogen; lb/d = pounds per day

As noted in the FPS, there has been an apparent change to the influent wastewater characteristics, especially related to the ratio of BOD to total suspended solids (TSS). Soluble organic flow-weighted concentrations have steadily increased annually since 2017, from 108 mg/L up to the current 2022 average flow-weighted concentration of 303 mg/L. Influent TSS concentration trends remain approximately the same over the same time span. The plant staff have been unable to identify the specific reasons for the recent BOD concentration increases except to note there appears to be less clean water infiltration and inflow (I/I) in the collection system (i.e., overall flows have gone down while growth has increased). Although if this was the case, the TSS concentration would also be expected to increase. The other potential source(s) is related to commercial activity contributing a significant soluble organic load such as a brewery or distillery. But to-date there is no evidence for this theory.

Influent total phosphorus (TP) concentration trends have also remained approximately the same since 2017, other than a spike in influent TP from February 22, 2022 through March 15, 2022. Operations determined that problems related to the TP analysis were the cause of the apparent high TP loads, not actual TP load. Historical maximum day TP loads have ranged from 47 to 64 lb/d from 2017 to 2021.

2.1 Existing Conditions

2.1.1 Existing Diffusers

The existing diffusers are Sanitaire® 9-inch fine-bubble ceramic diffusers and adequate for continued service in zones 2 and 3 of both AB 3 & 4. These diffusers were installed in 2005 with the original construction of the basins. The WRF tested the diffuser plugging for AB 3 & 4 in October 2021 and found plugging to be less than 10 percent. Ceramic disc diffusers typically have a lifespan of around 20 years. With the test results of the diffusers in Aeration Basins 3 & 4, these diffusers will likely be serviceable past the typical ceramic disc diffuser lifespan. The diffusers in Zone 1 will no longer be operated regularly so the ceramic type of diffuser discs should be replaced by membrane type. This keeps the mixed liquor solids from migrating into the air lines.

The diffusers in Aeration Basins 1 & 2 are ceramic fine bubble diffusers that were installed in 1984. Aeration Basins 1 & 2 originally used mechanical surface aerators from their construction in 1968 until they were replaced by the diffusers and centrifugal blowers for aeration. The diffusers have not been replaced and are still in the basins but have seen minimal use since the new basins were completed in 2005. Ceramic disc diffusers are prone to plugging without regular use and chemical cleaning. These diffusers will be replaced with the MLE conversion.

2.1.2 Existing Basin Structure

Concrete structures and buildings typically have a lifespan of around 50 years. Aeration Basins 3 & 4 were completed in 2005 and are approaching 20 years old. There are no apparent structural issues with the basins and should not require modification during the planning period.

Aeration Basins 1 & 2 were constructed in 1968 and are almost 55 years old. The center wall integrity is improved by two intermediate zone walls. There are no other apparent structural concerns for the two older basins #1 and #2.

2.2 Biological Modeling

2.2.1 Biological Modeling Update

The biological model was recalibrated using 2022 influent data. The model used the assumed influent TKN concentration of 40 mg/L instead of the lower 2022 influent samples (32.2 mg/L). Due to the variable nature of influent concentrations for all major wastewater constituents over the last five years, it was decided that the more conservative TKN values should be used until additional years' worth of influent TKN data can be collected.

With the biological model recalibrated to the 2022 plant operating data, a more detailed approach to the process modeling was able to take place. The updated model uses the following key assumptions:

- Peak month flow: 2.57 million gallons per day (MGD)
- Peak Month BOD load: 5,760 lb/d
- Peak month total Kjeldahl nitrogen (TKN) load: 860 lb/d
- Basin mixed liquor suspended solids (MLSS) concentration: 4,350 mg/L
- Aerobic solids retention time (SRT): 18 days
- Mixed liquor recycle (MLR) flow rate: 4Q peak month
- RAS flow rate: 0.8Q peak month

The recalibrated model found that running the MLR at 4Q instead of the 2Q identified in the FPS would not pose a significant risk of DO poisoning in the anoxic zone and further reduce the air demand in the aerobic zones. Running at this recycle rate is contingent on maintaining the DO concentration in the third cell at 1.5 mg/L.

The biological model predicted an aeration savings of 20 percent running in an MLE configuration versus the modeled existing plug-flow complete aeration process. Compared to actual aeration, which is higher than the current predicted air demand, MLE conversion will result in up to 22 percent aeration savings. This will significantly reduce the WRF's energy consumption, as the aeration process accounts for over 50 percent of the facility's daily energy usage.

The model predicts an effluent TN of 4 mg/L with a 4Q recycle rate. While the Ketchum / SVWSD WRF does not currently have any nitrogen species treatment requirements in its existing National Pollutant Discharge Elimination System (NPDES) permit, the reduced TN load discharged into the Big Wood River will continue to protect the long-term water quality of the watershed. This will also help to ensure that the TN limit of 30 mg/L in the recycled water permit are maintained, as the WRF currently has no treatment capacity to reduce TN.

A combination of anoxic and aerobic treatment conditions, as incorporated with the MLE system, also helps positively with sludge settling characteristics. Anoxic selector zones encourage growth of ordinary heterotrophic organisms, which tend to exhibit superior settling characteristics compared to a biological population without an anoxic selector.

Conversion to MLE will also present effluent alkalinity levels of 43 percent higher compared to complete aeration. Denitrification produces alkalinity, albeit at a reduced rate compared to consumption in the nitrification process. Alkalinity is sometimes needed in chemical phosphorus removal systems due to insufficient background alkalinity or large doses of coagulant for ultra-low phosphorus levels. The Ketchum / SVWSD WRF's influent wastewater has historically had sufficient alkalinity for chemical precipitation. The added alkalinity from denitrification will assure adequate alkalinity should lower phosphorus limits be required in the future.

2.3 Treatment Requirements

2.3.1 NPDES/IPDES Permit

The activated sludge system is the core treatment process at the Ketchum / SVWSD WRF. The aeration basins biologically remove BOD and ammonia-nitrogen (NH_3-N) from the wastewater. Under the administratively extended NPDES permit enforced by the United States Environmental Protection Agency (U.S. EPA) with effective date August 1, 2012, there are currently no limits on nitrogen species.

It is anticipated that the Idaho Department of Environmental Quality (IDEQ) will not write a new permit for the Ketchum / SVWSD WRF under the Idaho Pollutant Discharge Elimination System (IPDES) soon, so the existing NPDES permit will continue to govern effluent discharge limits to the Big Wood River. As related to the activated sludge system, the WRF will be limited to the constituent loads, concentrations, and minimum removal efficiencies shown in Table 3. The effective NPDES permit is also included in Appendix A.

Table 3. Current NPDES Permit Limitations

Constituent	Value	Monthly Average[1]	Weekly Average[1]
BOD	mg/L	30	45
	lb/d	505	760
	% Removal	85% (min.)	
TSS	mg/L	30	45
	lb/d	275	542
	lb/d	Annual Average Limit[2] = 145 lb/d	
	% Removal	85% (min.)	
E. coli Bacteria	CFU per 100 mL	126 (geometric mean)	406 (instantaneous maximum)
	CFU/d	Annual Average Limit: 19.1×10^9 CFU/d	
pH	s.u.	6.2 to 9.0 at all times	
TP	mg/L	1.0	1.5
	lb/d	9.9	14.9
Copper, Total Recoverable[2]	µg/L	19.2	35.1 (max day)
	lb/d	0.64	1.17 (max (day)

[1] Currently operating under permit dated August 1, 2012 (expired July 31, 2017), administratively extended.

[2] TSS limits were adjusted by EPA to an annual mass of 26.5 tons.

BOD = biochemical oxygen demand; TSS = total suspended solids; TP = total phosphorus; mg/L = milligrams per liter; lb/d = pounds per day; CFU = colony forming units; mL = milliliter; CFU/d = colony forming units per day; s.u. = standard units; µg/L = micrograms per liter

With the conversion of the Aeration Basins 3 & 4 from plug-flow complete aeration to MLE, the WRF will be able to biologically remove nitrate-nitrogen (NO_x-N), which will lower the effluent TN. While no nitrogen species are limited by the current NPDES permit, it is possible that the future IPDES permit may contain limits on nitrogen species. The "monitor only" criteria for ammonia-nitrogen in the Ketchum-SVWSD permit do hint at the possibility of a limit like that imposed in the City of Hailey NPDES discharge permit to the Big Wood River. Although not a direct benefit to the permit, removing nitrate-nitrogen in the effluent removes a nutrient contributing to eutrophication in the Big Wood River.

Eutrophication is a group of processes were dissolved nutrients, such as nitrogen and phosphorus, stimulate excess growth of aquatic plant life such as algae that can deplete the dissolved oxygen in the body of water. Reduced oxygen levels especially impact trout and salmonid species that rely on the cold, oxygen-rich river systems for spawning. By reducing the effluent nitrogen load and potential for eutrophication, the Ketchum / SVWSD WRF will continue to be stewards of environmental sustainability in the Wood River Valley.

2.3.2 Recycled Water Permit

The WRF has a municipal Class A recycled water permit issued by IDEQ on May 10, 2011. The recycled water permit allows both the City of Ketchum and SVWSD to beneficially use the Class A recycled water for any (current and future) approved use of Class A recycled water. The recycled water can be applied anywhere within the service areas of the City of Ketchum and the SVWSD so long as the buffers of 100 feet from recycled water application site to a private or public water supply well and drinking fountains, picnic tables, food establishments, and other public eating facilities are not in direct contact with recycled water irrigation spray are met.

The recycled water permit limits the WRF effluent to the constituent concentrations shown in Table 4.

Table 4. Current Recycled Water Permit Limitations

Constituent	Value	Arithmetic Mean	Instantaneous Maximum
Total Coliform[1]	CFU per 100 mL	2.2	23
Disinfection[2]	mg*min/L	-	450
Turbidity[3]	NTU	2	5
BOD[4]	mg/L	10	-
pH	s.u.	6.0 to 9.0 at all times	
TN[4,5]	mg/L	30	-

[1] Arithmetic mean determined from last 7 days with Total Coliform analysis.

[2] Process demonstrated to achieve 5-log inactivation of virus (i.e., 100 mJ/cm^2 UV dose) acceptable alternative

[3] Continuous measurement. Daily arithmetic mean.

[4] Monthly arithmetic mean as determined by weekly composite samples.

[5] Calculation by summation of TKN plus NO_x-N.

BOD = biochemical oxygen demand; TN = total nitrogen; CFU = colony forming units; mL = milliliter; mg*min/L = milligram-minutes per liter; NTU = Nephelometric Turbidity Units; mg/L = milligrams per liter; s.u. = standard units; mJ/cm^2 = millijoules per square centimeter; TKN = total Kjeldahl nitrogen; NO_x-N = nitrite-plus-nitrate-nitrogen

The recycled water permit includes a total nitrogen (TN) limit. The WRF recycled water effluent ranged between 4.06 to 27.50 mg/L from 2021 to 2022 with an average of 16.27 mg/L in 2021 and 14.92 mg/L in 2022. Most of the effluent TN is composed of nitrite-plus-nitrate-nitrogen (NO_x-N) since there are no denitrification processes currently at the WRF. This means that TN compliance is essentially contingent on influent TN being less than 30 mg/L.

With the conversion of the Aeration Basins 3 & 4 from plug-flow complete aeration to MLE, the WRF will be able to biologically remove NO_x-N, which will lower the effluent TN and provide flexibility if influent nitrogen characteristics change in the future.

3 MLE Equipment Evaluation

This section evaluates the different technologies used for wastewater aeration, determines the upgrade recommendations for the electrical infrastructure associated with the secondary treatment system, and the recommended approach to procurement and phasing.

3.1 Anoxic Zone Mixer

A mixer will be used to keep the MLSS suspended in the anoxic zone to ensure the biology has continuous access to NO_x-N to use as its oxygen source. Generally, mixers used to keep MLSS suspended are sized based on volume to be mixed. Typical design for these mixers provides 25 to 30 horsepower (HP) per MG. Using 30 HP/MG and the Zone 1 volume of 0.16 MG, the recommended minimum size for the anoxic mixer is 5 HP.

There are two commonly used styles of anoxic mixers: the banana blade mixer and the floating mixer. A banana blade mixer, named after the curved impeller blade's appearance, are submerged units that use guide rails for insertion and removal. Floating mixers typically use a circular fiberglass or stainless steel float with an exposed motor and submerged impeller. The impeller pushes the water downward. Floating mixers are typically held in place by stainless steel cables with springs to allow limited movement and cable detachment for moving the mixer to the side wall for maintenance.

Both technologies provide adequate mixing and will have negligible differences as far as mixing performance is concerned. The decision to use one technology over the other will be influenced by cost, visual appeal, and operator preference on maintainability.

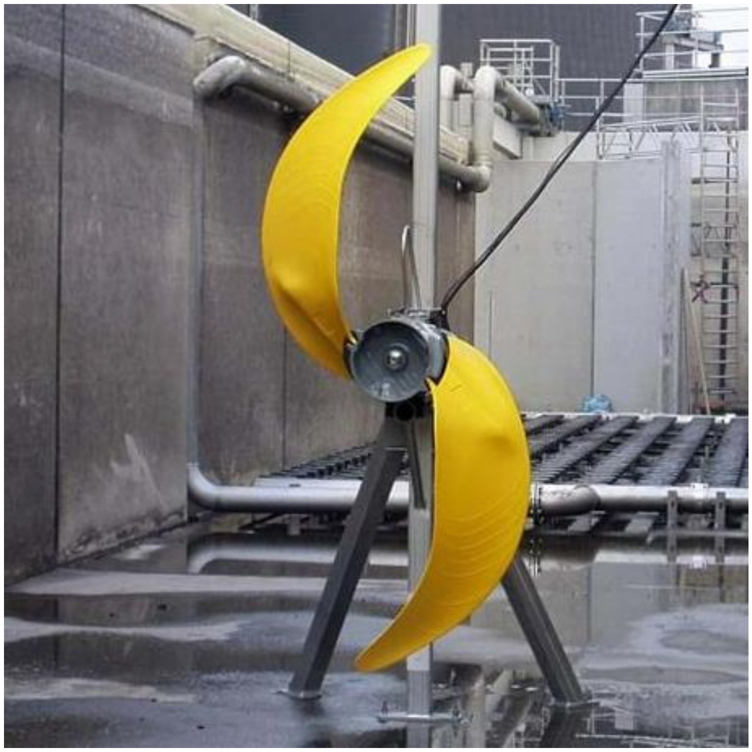


Figure 1. Example of a Submersible Banana Blade Mixer

(Source: Xylem Water Solutions)

Figure 2. Example of a Floating Mixer

(Source: Aqua-Aerobic Systems)

3.1.1 Mixer Technology Recommendation

Submersible mixing systems are typically more expensive than floating mixer systems, primarily due to the differences in the support structures and submersible motor. Submersible mixers require rigid stainless-steel rails with a winch, like the structures required for submersible pumps. Floating mixers use a series of three or more steel cables anchored into the basin walls.

The submerged mixer is not visually apparent while the floating type is. The submerged systems are generally only identified by the top end of the support rails and the winch, where the floating system is completely exposed. The fiberglass or stainless-steel floats are about 6-foot diameter and have the potential to become a “landing zone” for water birds, such as ducks. Occasional pressure cleaning of the float surface may be required for appearance purposes.

Both technologies are too heavy to remove from service without mechanical systems like a davit crane with a winch so maintainability differences in terms of removal are negligible. There is potential to maintain the floating mixer without removing it from the basin since the motor is exposed. The mixer can be pulled to the side wall and the float will support a person, although the safety of this practice is questionable.

The operators at the Ketchum / SVWSD WRF toured the Fruitland, Idaho’s WRF to see floating mixers in operation and discuss maintenance with operations. The feedback was positive about both reliability and maintenance. Since the floating mixers provide a significant capital savings and are preferred for maintenance, we recommend selection of floating mixers for the anoxic cells.

The floating mixer size recommendation for the basin configuration and volume is one 7.5 HP unit in each Zone 1. The MLE process is important for energy conservation but not critical to permit compliance. Therefore, a single unit is recommended. In the event of mixer problems, the activated sludge process train can return to full aeration until the mixer is repaired or replaced. The 7.5 HP mixer provides a mixing diameter of 59.5 feet, measured from the center point of the unit. The cell diagonal is approximately 60.5 feet, so approximately 6 inches in each corner of the anoxic cell may not have complete mixing. This volume is negligible compared to the overall cell volume.

3.2 Mixed Liquor Return Pump

The mixed liquor return (MLR) is an essential part of the MLE process. The MLR recycles nitrate-rich MLSS from the final zone of aeration back to the initial anoxic zone for denitrification. This recycle stream varies from return activated sludge (RAS) as MLR pulls MLSS from the last aerated cell instead of the settled solids (RAS) from the clarifier bottom. The MLR flow rate is much greater than RAS with flows 2 to 4 times the forward flow versus 0.5 to 1 times. This greater MLR flow volume returns far more nitrates to the anoxic zone than RAS for denitrification. The MLE flow schematic illustrating the MLR and RAS system is shown in Figure 3.

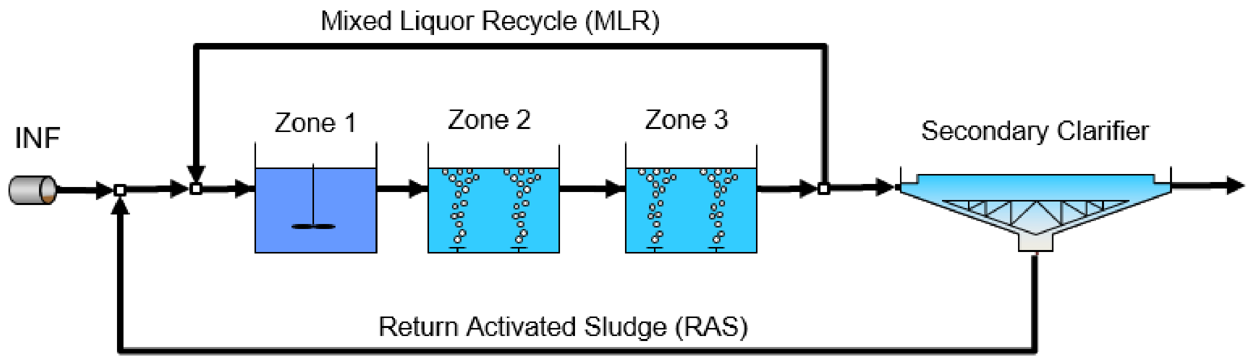


Figure 3. MLR Flow Schematic

The biological modeling indicates that an MLR flow rate of 400 percent of incoming plant flow at maximum month conditions will provide an optimal balance of denitrification while minimizing the potential for dissolved oxygen (DO) poisoning in the anoxic zone (HDR 2022). With the future design goal for three trains to each treat 0.86 MGD at maximum month conditions (one-third of planning period maximum month flow of 2.57 MGD), the MLR pumps will be conservatively sized to each return 1.71 MGD (or approximately 1,200 gallons per minute [GPM]) to the anoxic zone for each biological train. The pumps are anticipated to have 12-HP motors. The two-pump-per-train strategy maintains operational reliability by having the capacity to continue to recycle MLSS if one pump fails, albeit at a reduced rate. The MLR piping material is anticipated to be 8-inch 304L stainless steel.

A preliminary isometric of the proposed modifications to Aeration Basins 3 & 4 can be seen in Figure 4. As the isometric shows, the existing sump pumps and sump pump discharge piping will be removed from service.

The discharge header is configured to share service with both pumps operating together. The discharge header will contain six 4-inch orifices, divided evenly by a normally-open plug valve. If one pump is taken offline, then the plug valve on the discharge header above Zone 1 should be closed to maximize orifice velocity. The orifices will be located at the water surface level and pointed down. This will allow operators to visually inspect the orifices for any plugging and minimizes potential for DO introduction through the flow stream.

The MLR pumps can provide dewatering services, and the piping configuration is such that either MLR pump in the basins can be used to dewater. The sump pumps could be kept on the shelf to remove any leftover water the MLR pumps don’t remove.

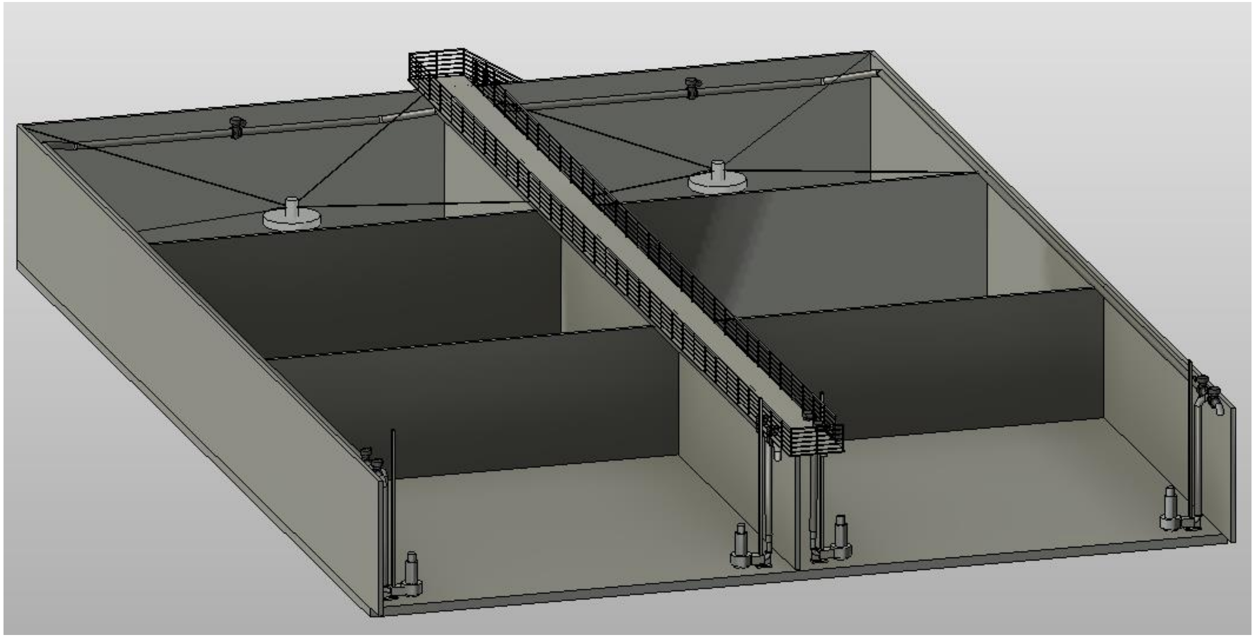


Figure 4. Preliminary Aeration Basin 3 & 4 Isometric

3.3 Equipment Procurement

Projects can be expedited by pre-procurement of key equipment which have extremely long lead times. Wastewater equipment generally has a delivery time of 20 to 30 weeks from issuance of the purchase order and in the last couple years due to supply chain issues has been longer. By procuring the equipment before construction bidding commences, the equipment can arrive on-site very close to the time that the contractor is ready to install the equipment. Pre-procurement can save months on the overall construction schedule. This is especially important in the Wood River Valley where the construction season is short due to winter snow conditions. We recommend pre-procurement of both the mixers and MLR pumps.

3.4 Equipment Phasing

The phasing of equipment will follow the project schedule identified in the FPS. The anoxic mixers and MLR pumps for Aeration Basins 3 & 4 will be purchased in fiscal year (FY) 2023. The MLE conversion in FY 2024 provides conservation of aeration basin air and goes together with the Aeration Blowers project. The process conversion allows the biological system to continue operating on Aeration Basins 3 & 4. The upgrading of Aeration Basins 1 & 2 is not scheduled for several years (2027) when the full aeration basin MLE conversion is complete. The detailed schedule for MLE conversion is included in Section 7.

4 Electrical and Controls

The secondary treatment system electrical infrastructure will be upgraded with replacement of the aeration basin blowers in 2024. MCC-2 is scheduled for replacement at that time. The electrical upgrades will include service for the future mixers and MLR pumps for Aeration Basins 3 & 4 and reserved electrical space for the future mixers and MLR pumps for Aeration Basins 1 & 2. The electrical upgrades associated with MCC-2 are further discussed in the Aeration Basin Blowers Technical Memorandum (HDR 2023).

The mixers are operated continuously and are constant speed. MLR pumps have operational flexibility and are operated based on a ratio of influent flow. The MLR pump VFD will be adjusted to obtain the set-point multiplier. Flow meters for this function are not necessary as the accuracy of the pumped flow is not critical, just the relative magnitude of recycled flow. The denitrification performance will be monitored to find the flow multiplier set point best meeting the treatment goals. During startup the flow curve at various pump speeds will be programmed into the SCADA PLC, roughly for pump frequencies from 20 Hz to 60 Hz. Based upon the flow rate multiplier selected, from 1 to 4 Q, the controller will adjust the pump speed. The pumps in each Zone 3 will be set to the same pump speed and adjusted together. And normally two aeration trains are operating, so the flow target (based on the flow multiplier) will set the four pump speeds based upon dividing flow into four.

5 Site Evaluation

The conversion of Aeration Basins 3 & 4 from a plug-flow complete-mix process to the MLE process will not add any new structures or alter the footprint of the Ketchum / SVWSD WRF. The upgraded equipment will be located within Aeration Basins 3 & 4.

The orientation of the Aeration Basins, the MLE equipment, and new electrical room are shown in Figure 5.

5.1 Existing Facilities

Aeration Basins 3 & 4 were originally constructed in 2005. The structure is in good condition and should not require any structural modifications to facilitate the process conversion. The diffuser ceramic discs in Zone 1 will be replace by membrane discs by unscrewing the retaining cap of the PVC assembly and simple disc replacement. Aeration piping may need to be adjusted in aeration basin Zone 3 to accommodate the MLR submersible pumps. Recycle piping will be mounted along the tank wall.

5.2 Electrical Constraints

The existing Aeration Blower Building electrical equipment area is currently space constrained. Modifications to add an electrical room to the building will be necessary to accommodate the future blowers and upgraded MCC-2. Feeder 1 serves MCC-2 and provides up to 1,000 amps for the secondary treatment system equipment and is adequate to accommodate the upgrades.

5.3 WRF Modifications

5.3.1 Aeration Basin Modifications

The aeration basin air headers and diffuser laterals will need only minor modifications in Aeration Basins 3 & 4. The ceramic diffuser discs in the first cell (Zone 1) of each basin can be replaced with membrane discs. Ceramic fine bubble diffusers, which are currently in service in the basins, allow mixed liquor to slowly enter the piping if left off. As these solids dry out inside the pipe, they can cause diffuser plugging from the inside.

The existing diffuser layouts are in Appendix D. There are 410 diffusers in each Zone 1 area, 290 diffusers in each Zone 2 area, and 160 diffusers in each Zone 3 area. Once Zone 1 becomes anoxic, the aeration duties shift to Zones 2 and 3. This will require adding diffusers to these zones. The available blanks in each Zone 2 are 127 and the available blanks in each Zone 3 are 160. Modeling results in Table 5 show the following progression of basin use and air flow in Zones 2 and 3 at maximum month conditions.

Table 5. Air Requirements in Zones 2 and 3 with Increased Flow

Maximum Month Plant Flow (MGD)	Number of Trains	Zone 2 Airflow (SCFM)	Zone 3 Airflow (SCFM)	Total Airflow (SCFM)
1.22	2	1,200	550	1,750
2.06	3	1,925	880	2,805
2.22	4	1,895	850	2750
2.39	4	2,105	950	3,055
2.57	4	2,345	1,065	3,410

MGD = million gallons per day; SCFM = standard cubic feet per minute

After adding 127 diffusers to each Zone 2, the airflow will be approximately 1.5 standard cubic feet per minute (SCFM) per diffuser. After adding 160 diffusers to each Zone 3, the air flow will be approximately 0.9 SCFM/diffuser. The manufacturer's desired airflow is 1 SCFM/diffuser. We recommend replacement of all ceramic membranes in Zones 2 and 3 with flexible EPDM membranes.

In the second phase of MLE conversion, significant modifications will be required to Aeration Basins 1 & 2. Each basin will have two baffle walls constructed to produce three equally sized cells, mirroring Aeration Basins 3 & 4. The baffle walls will also serve to support the center wall. A catwalk will be installed along the center wall like the existing Aeration Basin 3 & 4 catwalk. Diffuser lateral piping will be replaced due to the zone configurations. The diffusers will be replaced with membrane fine bubble diffusers. The ceramic diffusers in Aeration Basins 1 and 2 are original to the 1984 construction. As mentioned above, membrane diffusers are better suited to extended periods of non-use compared to ceramic diffusers. All diffusers in Aeration Basin 1 and 2 will be replaced with membrane type. New diffusers may need to be installed in Zones 2 & 3 in the blank diffuser locations for Aeration Basins 3 & 4 to provide adequate air in these cells. A mix of membrane types is not necessary or wanted.

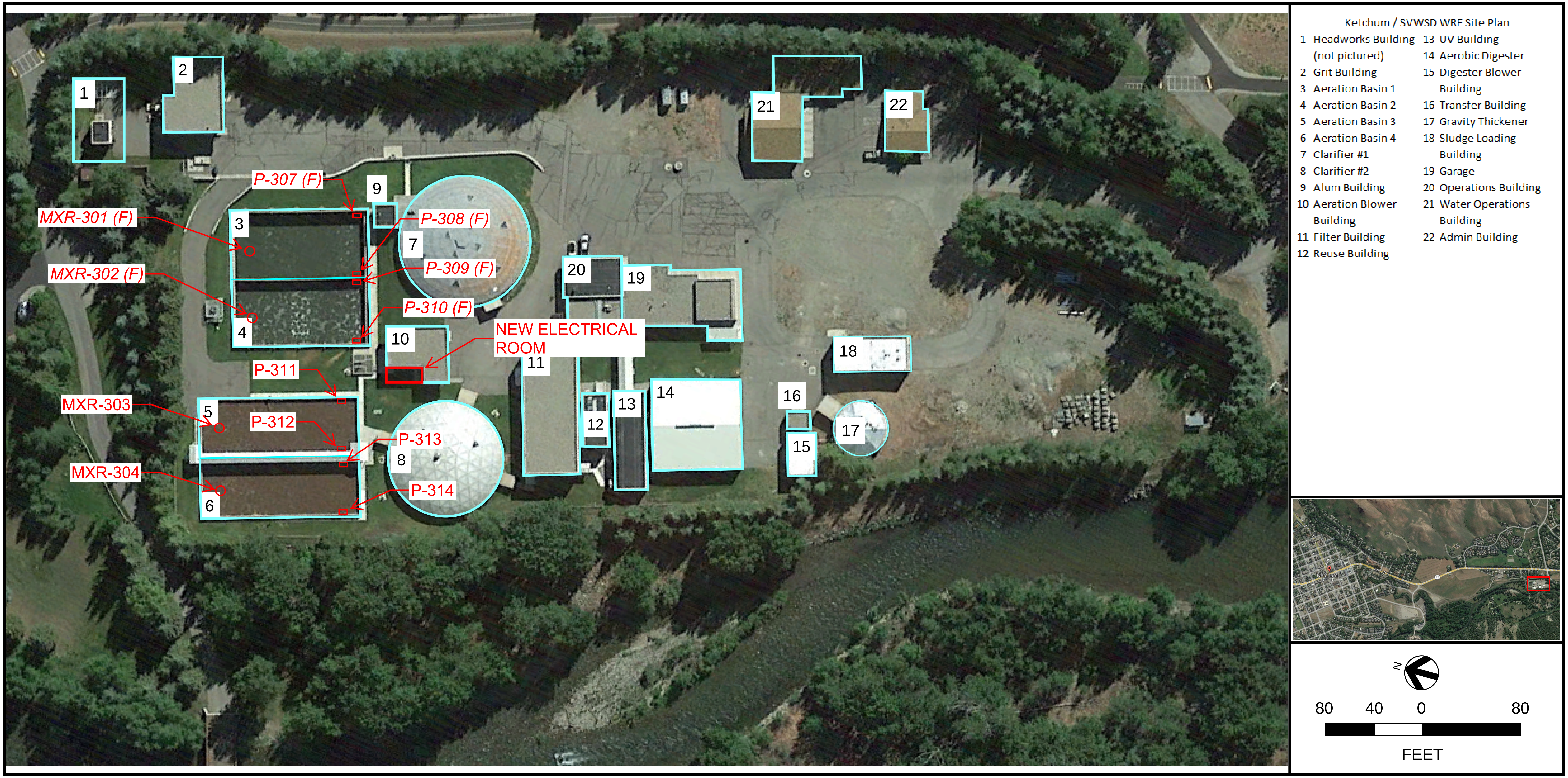


FIGURE 5. SITE PLAN FOR MLE CONVERSION MODIFICATIONS

This page is intentionally left blank.

5.4 Treatment During Construction

The FPS identified the capacity of the activated sludge system at 8,340 lb/d BOD based on a design F:M ratio of 0.10 lb BOD/lb MLSS/d (HDR 2022). Given that the four basins are each approximately 0.5 MG, each basin can treat up to 0.82 MGD based on the 2022 flow-weighted influent BOD concentration of 303 mg/L. This means that Aeration Basins 1 & 2 must be put into service while Aeration Basins 3 is taken offline for upgrades, since Aeration Basin 4 does not have sufficient capacity to treat flows on its own. When basin 1 or 2 is in service, the water level should be equalized in the other side to avoid uneven hydrostatic loading that could damage the center wall. The new baffle walls will stiffen the center wall and solve this structural problem.

It is recommended to upgrade Aeration Basin 3 first and then Aeration Basin 4 once Aeration Basin 3 is completed. Recent basin draining revealed grit accumulation from the floor to the bottom of the diffusers. Operations staff removed the grit in Basin 3 but did not have time to clean Basin 4. Basin 4 grit removal will be included in the MLE conversion project.

6 Cost Summary

6.1 Aeration Basins 3 & 4 Conversion

The preliminary engineering Opinion of Probable Construction Cost (OPCC) for Aeration Basins 3 & 4 MLE conversion is outlined in Table 6. The costs are developed from predesign planning with site-specific consideration. The FPS cost estimates were considered an "order-of-magnitude" estimate, or a Class 4 estimate (AACE 2020), as the project definition through that portion of planning was approximately 10 percent. The anticipated accuracy range is plus 40 percent and minus 20 percent at this stage of design. This technical memorandum expands the project definition to a Predesign level, which typically requires approximately 30 percent project definition. Predesign detail allows a Class 3 estimate with an expected accuracy range of plus 30 percent and minus 15 percent.

Unit costs presented below are based on a combination of previous project experiences, vendor quotes, and HDR's experience with material procurement in the recent months. The table presents costs for the MLE conversion of Aeration Basins 3 & 4.

Table 6. OPCC Summary – Aeration Basins 3 & 4 Conversion

Line Item	Quantity	Unit Price	Total[1]
Aeration Basin 4 Cleaning	1	LS	$45,050
Floating Mixers	2	$27,190	$54,380
MLR Pumps	4	$55,200	$220,800
Diffuser Insert Replacement[4]	1,720	$30.83	$53,020
New Diffuser Assemblies[5]	574	$40.92	$23,490
Piping	1	LS	$193,500
Electrical Components	1	LS	$97,500
		Subtotal	$687,740
Contingency	%	20%	$137,550
		Subtotal	$825,290
Contractor's OH & Profit	%	30%	$247,590
Sales Tax[2]	%	6%	$28,420
		Total[3]	**$1,101,300**
		Expected Upper Limit (+30%)	$1,431,690
		Expected Lower Limit (-15%)	$936,110

[1] Costs are shown in 2023 dollars and are not escalated to the year of procurement and construction.
[2] Contractor's overhead and profit includes sales tax on real property that is not Owner Furnished.
[3] The total shown is accurate with a range of +30% and -15% of the value shown per AACE Class 3 estimate.
[4] Replace all 410 diffusers in Cell 1, 290 diffusers in Cell 2, and 160 diffusers in Cell 3 for each basin (1,720 total existing).
[5] 127 blank diffusers in Cell 2 and 160 blank diffusers in Cell 3 for each basin (574 total blanks).
LS = lump sum; OH = overhead

The projected cost for the Aeration Basin 3 & 4 MLE Conversion, which fell under the 2023 implementation lines identified in Table 7-4 of the FPS (HDR 2022) was $987,000 in 2022 dollars with an accuracy range of plus 40 percent and minus 20 percent (cost range from $790,000 to $1.382 million).

The OPCC for the work described in this TM is $1.101 million (equivalent to $1.034 million in 2022 dollars with a January 2023 inflation rate of 6.5 percent [Statista 2023]), which is approximately 5 percent more than the original cost projection.

7 MLE Implementation Plan

The implementation schedule to complete the Aeration Basins 3 & 4 MLE Conversion project is driven primarily by equipment delivery and the construction season. Since the Wood River Valley experiences heavy snowfall during the winter, construction activities generally cannot begin before April and all building construction should be completed by the end of October (unless interior work). Much of the electrical work associated with the project will be indoors once the new electrical room is constructed, and there should be a minimal requirement for excavation except for electrical conduit runs to mixers and MLR pumps.

The current implementation plan for Aeration Basins 3 & 4 is to complete the detailed design in early 2023, order long-lead equipment by summer 2023, bid construction in the fall 2023, and complete equipment installation summer of 2024. Aeration Basins 1 & 2 will not require conversion to the MLE process until mid-2029 due to the additional capacity from upgrading Aeration Basins 3 & 4. The MLE conversion schedule for Aeration Basins 3 and 4 is shown below.

Task	Initiation	Completion
Aeration Basins 3 & 4 MLE Conversion		
Mixer and Pump Procurement Bid Pkg	April 2023	May 2023
Procurement Award	June 2023	June 2023
Detailed Design	April 2023	June 2023
DEQ Review	July 2023	Aug 2023
Bidding Equipment Installation	Aug 2023	Oct 2023
Equipment Submittals and Delivery	Aug 2023	Dec 2023
Installation Construction	Dec 2023	June 2024
Startup	July 2024	Sept 2024

8 References

AACE International [AACE]. (2020). *18R-97: Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries* (August 7, 2020).

HDR. September 2022. *Facility Planning Study.*

HDR. March 2023. *Aeration Basin Blowers Technical Memorandum.*

Metcalf & Eddy, Inc., Tchobanoglous, G., Abu-Orf, M., Bowden, G., & Pfrang, W. [M&E]. 2014. *Wastewater Engineering: Treatment and Resource Recovery* (5th ed.). McGraw-Hill Education.

Statista. February 2023. *U.S. Monthly Inflation Rate January 2023.* Retrieved February 28, 2023, from https://www.statista.com/statistics/273418/unadjusted-monthly-inflation-rate-in-the-us/