Lewiston-Auburn Wastewater Pollution Control Authority

Anaerobic Digestion / Energy Recovery Project

August, 2010

Response to Value Engineering Study Report - DRAFT

Section 1
Value Engineering Report Response Summary

1.1 Report Summary

This report responds to the 30% Design Submittal Value Engineering (VE) Workshop Report, dated August, 2010, prepared by ARCADIS for the Lewiston Auburn Water Pollution Control Authority - Anaerobic Digestion \ Energy Recovery project.

The VE workshop was held July 27 through July 29, 2010 at the LAWPCA treatment facility. The objective of the VE effort was to review the 30% Design Submittal, perform a functional analysis on the project, identify cost saving items, and present design modifications, which would improve the overall functionality, constructability, and value of the project.

The VE workshop generated a total of 14 design specific recommendations\comments. Each recommendation was assessed using the following criteria:

- Accepted as written;
- Accepted but Modified;
- Rejected for Specific Reasons;
- Comment Noted/Will be Considered.

Most of the recommendations received were either accepted as written or accepted but modified. Two stand alone recommendations were accepted, and the rest were either rejected for specific reasons or will be considered in further design.

The total net capital cost savings from the accepted alternatives is estimated to be about $2,626,000. These savings are based on the same 161% markup of raw costs as presented in the 30% opinion of construction cost that was previously provided during VE workshop to all participants.

A summary of the VE Report recommendations, CDM's response and estimated cost impact for each design recommendation has been summarized in Table 1-1 below. Detailed responses to each comment are included in Section 2 of this report.

Table 1-1 presents a comparison between the VE's estimated savings and CDM's estimated savings on the items that were accepted. The difference in estimates is due to increased costs, or decreased savings, that were realized for the accepted items once they were examined in more detail.

Table 1-1
VE Session - Design Recommendations

No.	*Description*	*VE Savings Estimate Based on 30% Design Submission*	*CDM Savings Estimate for Accepted Comments*	*Disposition of VE Recommendation*
SA-1	Use common wall construction for the Anaerobic Digester Tanks, Digested Sludge Storage Tanks, and Digester Equipment Building	$210,000	**$0**	**Rejected For Specific Reasons**
SA-2.	Eliminate Parapet walls on the Gas Conditioning Building and Digester Equipment Building Accepted as Written	$27,000	**$12,000**	**Accepted but Modified**
SA-3.	Use Conventional windows at the digester equipment building in lieu of the translucent panels.	$22,000	**$0**	**Rejected For Specific Reasons**
D-4.	Reduce the number of digester mixing pumps to provide 2 duty and 1 standby.	$83,000	**$83,000**	**Accepted as Written**
D-7	Use the same type of pumps for both the belt filter press feed and digester feed pumping systems	$36,000	**$0**	**Rejected for Specific Reasons**
GCB-1	Combine the Gas Conditioning Building with the Digester Equipment Building.	$143,000	**$0**	**Rejected for Specific Reasons**
M-1	Reduce the number of motorized valves used on digester piping	$145,000	**$ 145,000**	**Accepted but Modified**
E-1	Use Rigid Galvanized steel conduit in lieu of PVC coated rigid galvanized steel conduit proposed.	$52,000	**$52,000**	**Accepted as written**
E-2	Delete local motor disconnect switches for equipment	$42,000	**$42,000**	**Accepted as written**
E-3	Move cogeneration units closer to the main switchgear to reduce wire and conduit costs.	$36,000	**$0**	**Comment Noted/Will be Considered**

E-4	Continuously ventilate the basement of the Digester Equipment Building with 6 air changes per hour and change area classification	$137,000	**$112,000**	**Accepted but Modified**
E-5	Use fixed mounted circuit breakers in lieu of drawout type of switchgear main and cogeneration mains.	$21,000	**$0**	**Rejected for Specific Reasons**
E-6.	Reduce number of spare breakers in main switchgear.	$60,000	**$60,000**	**Accepted as written**
E-12	Delay the installation of the Cogeneration Facility and appurtenances until additional funds are obtained thus improving project economics.	$4,267,000	**$2,120,000**	**Accepted but Modified**
	Estimated Savings:	**$5,281,000**	**$2,626,000**	

Section 2
Individual Responses to Comments

Presented below are the individual responses to the Value Engineering (VE) workshop comments and design recommendations. Each response includes details related to CDM's acceptance/rejection of each individual comment.

2.1 Response to Design Comments \Recommendations

Recommendation (SA-1) – Consolidate Tank and Building Structures

Use common wall construction for the Anaerobic Digester Tanks, Digested Sludge Storage Tanks, and Digester Equipment Building

Rejected for Specific Reasons

The design concept of utilizing common wall construction for digester tanks and equipment building structures to reduce overall excavation /fill quantities and minimize the quantity of yard piping required between structures was previously evaluated by CDM during preliminary design and determined to be more costly to fully develop than concepts involving structures that did not utilize common wall construction.

The VE team identified $210,000 in potential cost savings in each of the following areas; concrete work, earthwork, and yard piping.

Table: SA-1 VE Cost Savings breakdown

Item:	*Original Qty*	*Original Raw Cost*	*Alternate Qty*	*Alternate Raw Cost*	*Savings (Raw Cost)*
Concrete	571 c.y.	$306,000	601 c.y.	$312,500	(+) $6,500
Excavation	20,000 c.y.	$40,200	16,800	$33,768	$ 6,432
Imported Fill	6,440 c.y.	$131,054	6,440	$131,054	$ 0
Backfill	7,000 c.y.	$19,740	5,880	$16,582	$ 3,158
Spoils	13,000 c.y.	$224,770	10,920	$188,807	$ 35,963
Yard Piping	l.s.	$90,435	0	$0	$90,435
				Total + Markup:	$210,000

Note Raw costs Presented above, multiply by 1.61 for project costs.

Concrete

Concrete work costs associated with common wall construction were found to be more expensive due to additional quantity of concrete required to construct the combined structures. Additional concrete is required for common wall construction since all structures would be sharing a common foundation. The base slab would

require significantly more concrete and steel to help prevent uplift of structures due to the high groundwater levels present onsite.

Earthwork
Earthwork cost savings identified during the VE were primarily attributed to a reduced quantity of spoils generated resulting in a total savings of approximately $35,000.

Yard Piping
The elimination of the yard piping between the separate structures represented the single largest overall cost savings ($90,435) item identified by the VE that would result by combining structures.

The VE team did not account for any new interior piping required to be installed to connect the digester overflows, drain lines, or biogas piping that were previously included in the yard piping estimate. The revised digester & building layout proposed by the VE would require additional interior piping and valves be provided to accommodate the new layouts. Accounting for this additional piping will eliminate all yard piping cost savings identified.

Electrical Area Classification Considerations
The primary factor contributing to the recommendation for the design of independent structures was the impact that common wall construction would have on the electrical classification of the digester equipment building.

NFPA 820 Figure A.6.2(c) defines area classifications envelopes for digesters and adjacent equipment rooms. Per NFPA 820 digesters and surrounding adjacent spaces are classified as Class I Div I areas that are subject to exposure to explosive gases. The area classification extends 25 feet above the gas dome and 10 feet around the digester.

Since the entrances to the digester building and electrical rooms are not gas tight and do not meet NFPA's requirements for physical separation. In the common wall construction layout proposed by the VE, the digester equipment building entrances would likely fall within the Anaerobic Digester envelope per NFPA 820 table 6.2(a), Row 15(a) exposing the upper level of the building and electrical room to biogas. High rate ventilation of the spaces would not adequately declassify the spaces due to the proximity of the air handling units within the classified area envelope of the digesters. In this combined layout, all areas of the equipment building would be classified as Class I Div I which would significantly increase construction costs to provide Class I Div I rated equipment.

Hotwater Supply / Boiler System - Gas fired boilers are not commercially available as being rated for installation in Class I DIV I/II areas, thus the boilers would require to be installed in separate structure or back in main operations building. Relocation costs associated with additional hot water supply /return piping, biogas piping, larger hot

water circulation pumps, increased boiler capacity, and construction of a new boiler room would be incurred if boilers were required to be located in the operations building.

Electrical Room Relocation – the classification of the digester equipment as a Class I Div I area would impact the cost of the electrical room equipment. Providing Class I Div I rated MCC's would not be a cost effective option and would require a larger electrical room be provided to accommodate the NEMA 7 ("explosion proof") MCC's. A more practical approach would be to relocate the electrical room beyond the NFPA required digester buffer, but this would also be an expensive option as additional structures, conduit and wires would be required.

By designing the digester and sludge holding tanks as independent structures separate from the digester equipment building, many of the issues associated with area classification and associated impact on electrical components can be avoided. CDM feels that this design approach represents the most cost effective facilities layout that meets the requirement of NFPA 820.

The recommendations as outlined above resulted in a zero net project savings as opposed to the $210,000 as recommended by the VE.

Recommendation (SA-2) – Eliminate Parapets

Eliminate Parapet walls on the gas conditioning building and Digester Equipment Building roofs.

Accepted but modified

CDM will evaluate the elimination of rooftop parapets from structures, however due to the presence of rooftop HVAC equipment requiring periodic maintenance, fall protection (guardrail at 3'-6"height) is required to be provided around any equipment within 10 ft. from the edge of the building. This may require a combination of shorter parapet and guardrail or a full height (3'6") guardrail.

CDM feels that providing a CMU block parapet wall would be the more durable long term solution for providing the required fall protection, however a fixed guardrail option would provide a marginal cost savings over installing a CMU parapet wall.

The estimated project cost savings associated with the implementation of this comment are anticipated to be approximately $12,000 vs. the $27,000 savings identified during the VE.

Recommendation (SA-3) –Utilize Conventional Windows

Use conventional glass windows at the digester equipment building in lieu of the translucent panels proposed.

Rejected for Specific Reasons.

The proposed Kalwall panels (translucent wall panels) were not found to be more expensive than the VE proposed aluminum framed windows of the same size, with thermally broken frames and fully insulated 1" thick glass. The VE costs used for conventional glass windows were not consistent with the same size and thermal value panels as proposed by CDM. The VE had proposed utilizing much smaller windows than originally proposed by CDM. One of the design objectives for providing large translucent panels was to maximize natural lighting and reduce electrical lighting costs within the equipment building. Smaller windows as proposed by the VE would not provide sufficient lighting and would require additional windows be provided to match natural day lighting provided by the larger translucent panels.

Translucent wall panels were selected as the preferred window type due to their low cost, high thermal energy value, and ability to diffuse low light throughout the interior spaces. Translucent wall panels are routinely used in wastewater / water treatment facilities due to their low cost, robust design, and ability to be removed and reinstalled by plant staff. Conventional insulated glass windows are typically more expensive and there use is limited to applications were diffuse lighting is not required or occupied spaces requiring exterior visibility.

The estimated project costs associated with the implementation of this comment are anticipated to increase project costs approximately $3,500 vs. the $27,000 savings identified during the VE.

Recommendation (D-4) – Reduce No. Of Digester Mixing Pumps

Reduce the number of digester equipment pumps to provide 2 duty and 1 standby pump.

Accepted as Written

The original 30% design included providing a duplex mixing pump arraignment for each digester requiring a total of 4 mixing pumps be provided.

By reconfiguring mixing pumps to be installed in a triplex pump arraignment (2 duty and 1 stand-by) in the southeast corner of the lower level of the equipment building a fourth mixing pump is no longer required and can be eliminated thus reducing overall capital costs for tank mixing. The conversion to a triplex pump arraignment is only feasible utilizing the current digester tank and equipment building layout as shown on the 30% drawings where digesters No.1 and No.2 are directly adjacent to each other.

The triplex pump layout as proposed will allow for the digester mixing pumps to share common suction and discharge manifolds however it will require the relocation of the digester recirculation pumps from their current location. The digester recirculation pumps will need to be relocated to the Southeast corner of the lower level equipment room.

The use of a triplex digester mixing pump layout will not significantly reduce the overall dimensions required for the lower level of the digester equipment building due to physical and operational requirements for equipment, piping, and manifolds in relation to the digester tanks.

The estimated project cost savings associated with the implementation of this comment are anticipated to be approximately $83,000.

Recommendation (D-7) – Standardize Sludge Feed Pumps

Utilize the same type of pumps for both the belt filter press feed and digester feed pump systems.

Rejected for specific Reasons

The 30% design documents identified the need for (4) new digester feed pumps and (3) new belt filter press feed pumps. Technical memos (TM W-2 Digester Feed Pumps) and (TM W-9 Belt Filter Pumps) present an evaluation of available pump options and recommendation of preferred pump style for each application.

For both the digester and belt filter press feeds applications, Rotary lobe pumps were identified by CDM as being the recommended pumps for that application. CDM also concurs that similar pump styles should be used when possible and appropriate for the intended applications. However due to different feed rates and sludge viscosities involved in each feed application (38 gpm vs 180 gpm), CDM is not recommending the use of same size pumps for both applications.

Although the same "style" of pumps can be used for both applications, the use of the same capacity pumps as suggested during the VE workshop for both feed applications is not recommended due to numerous operational issues and differences in sludge viscosity, solids content, and pumping distances for each application.

The existing digester feed pumps are currently sized to pump at 0-38 gpm @ 100 PSI, based on a 15 day digester feed SRT. Should higher digester feeds rates be required, the current design allow operators to increase digester feed rates by bringing multiple digester feed pumps online to increase overall digester feed capacity for short durations. Long term operation of multiple sludge feed pumps (or sustained feed rates in excess of 38 gpm) is not advisable since the Sludge Heat Exchanger (SHEX) system that preheats incoming sludge is sized based on digester feed rate of up to 38 gpm. Sustained feed rates in excess of 38 gpm could result in digester process upsets due to increased digester loading and insufficient preheating of feed sludge. Resizing of the SHEX to match higher digester feed pump capacity would result in an overall

cost increase and not provide an operational advantage that could be effectively utilized for the digesters as designed.

This design change to match associated with this comment are not recommend and would result in overall project cost increases and not cost savings as proposed by the VE workshop.

Recommendation (GCB-1) – Combine Gas Conditioning Building with Digester Equipment Building.

Combine the gas conditioning equipment building with the digester equipment building to reduce building costs.

Rejected for Specific Reasons

Consolidation of the gas conditioning building with the digester equipment building will be difficult to implement without impacting the electrical area classification of the remainder of the digester equipment building..

The original 30% design kept the two structures separate and independent due to numerous code requirements per NFPA 820 as follows:

- The gas conditioning room must be physically separated (Gastight) from the digester equipment building per NFPA 820 Table 6.2(a) Row 16(c) and Table 6.2(a) Row 9(a).

- The gas conditioning equipment must maintain a 5ft clearance from unclassified areas. The 5 foot radius is rated Class 1 Division 1 per NFPA 820 Table 6.2(a) Row 17(c). This will change the footprint area of the gas conditioning room as proposed by the VE team.

- An independent ventilation system for the Gas Handling room is still required to meet the NFPA ventilation requirements for Class I Div I spaces. Consolidation of the structures would require the ventilation system to operate continuously at 12 ACH to minimize impact to adjacent spaces.

The changes as outlined above will result in a net increase as opposed to the $143,000 as recommended by the VE.

Recommendation (M-1) – Eliminate Motorized Valves

Reduce the number of motorized valves being used on digester mix / recirculation piping. Provide manual valves.

Accepted with modifications

The elimination of motorized valves on pump suction and discharge piping and replacement with manually actuated valves would result in an overall cost savings as identified during the VE workshop.

The original 30% design drawings currently show the following process valves to be installed with motor operators:

Valve Size	*Process Line*	*Quantity*
14 inch	Digester mixing - discharge	4
16 inch	Digester mixing -suction	4
10inch	Holding Mixing - discharge	4
12-inch	Holding Mixing - suction	Qty – 2

Due to the valve sizes involved, large diameter valves were originally proposed to be furnished with motor operators to provide operators with a rapid means of operating large diameter valves which typically require multiple turns to open/close. Although these valves will serve as isolation valves, it is important to routinely exercise critical isolation valves to ensure they can be operated when required. The elimination of motor operators for these valves will require operators to manually open / close each valves via a hand wheel and or /chain wheel.

This design changes associated with this comment would result in overall project cost savings of $145,000.

Recommendation (E-1) – Galvanized Conduit

Utilize conventional rigid galvanized conduit in lieu of the PVC coated rigid galvanized conduit proposed.

Accepted as written

CDM typically recommends the installation of PVC coated rigid galvanized steel conduit for corrosive areas. PVC coated rigid galvanized conduit provides significantly more protection in corrosive areas such as the digesters and gas conditioning areas than galvanized conduit alone. However, rigid galvanized steel conduit is also acceptable for use in corrosive areas per the NEC.

Pending the approval of LAWPCA, rigid galvanized steel conduit can be furnished in lieu of the PVC coated conduit as specified.

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CDM estimates that the changes, as outlined above, will result in a net savings of $52,000.

Recommendation (E-2) – Delete local motor disconnects

Delete local motor disconnect switches for all equipment.

Accepted with Comments

Installing a disconnect switch in close proximity to the operating equipment provides a local means to shut down equipment in an emergency situation or positive means of local disconnect during routine maintenance. Elimination of local motor disconnects can be accomplished provided that LAWPCA plant staff have a lockout/ tag out procedure in place to satisfy NEC 430.102 (2) Exception (b) and LAWPCA can validate that their electrical lock out tag out program, meets NFPA 70E-2004, Standard for Electrical Safety in the workplace.

The changes as outlined above resulted in a net savings of $42,000 .

Recommendation (E-3) – Relocate Cogen

Relocate COGEN equipment skids 200 ft closer to the main switchboard.

Comment Noted / Will Be Considered

The final location of the cogen units will be highly dependent on local site conditions (i.e. geotech, and underground utilities) and the current location shown on the 30% drawings has yet to be confirmed by boring data as suitable for supporting the equipment. Previous locations evaluated for locating the cogen system closer to the main switch were found to be unsuitable due to poor soil conditions in the vicinity of the gravity thickener tanks. Although locating cogen equipment closer to the main switchgear may result in a cost savings associated with wire and conduit, other costs associated with pile foundations, hot water supply/return piping, and biogas piping would increase. CDM will consider this recommendation further during final design.

At this time no cost savings can be realized resulting from the relocation of cogen as recommended during the VE.

Recommendation (E-4) – Declassify Lower Level of Digester Equipment Building

Provide continuous ventilation of the lower level of the digester equipment building with 6 Air Changes per Hour (ACH) and change area classification from Class I Div II to declassified.

Accepted but modified

The lower level of the digester equipment building is currently designated as a Class I Division II space requiring < 6 ACH of ventilation. During preliminary design discussions were held to evaluate if the area classification should be changed from Class I Division II to declassified through increased ventilation. At that time it was determined that the lower level should remain Class I Div II in order to minimize overall life cycle costs associated with ventilation and heating of this space.

According to NFPA 820 Table 9.1.1.4 Minimum Ventilation Rates Row 2(c) – class I Division II spaces require a minimum of 6 ACH be provided to declassify the space. Additionally, the code also indicates that ventilation must be provided by a standalone ventilation unit dedicated to that space. The current design includes a separate ventilation unit which has sufficient capacity to provide up to 6 ACH as required and would not require to be changed to satisfy the ventilation requirements.

Additional gas safety equipment consisting of combustible gas detection equipment would be required to be provided meet NFPA declassification requirements. This equipment is valued at approximately $25,000 and was not included in the previous cost.

Declassification of the area will allow for less expensive non classified conventional motors and lighting fixtures to be furnished. The anticipated savings by utilizing unclassified rated equipment is estimated to be approximately $137,000.

The recommendations as outlined above resulted in a net project savings of $112,000 as opposed to the $137,000 as identified by the VE.

Recommendation (E-5) – Use Fixed Mounted Circuit Breakers

Utilize fixed mounted circuit breakers in lieu of drawout type of switchgear of breakers at main switchgears and cogeneration mains

Rejected for Specific Reasons

The draw-out style circuit breakers as proposed for the cogen units (800 amp (x2)) and service main (3200 amp) provide operators with positive means of electrical disconnect and are the preferred means of disconnect required by Central Main Power for all main switchgear breakers. This style circuit breaker also simplifies service and maintenance of the circuit breakers and is currently on existing switchgear throughout the plant.

The use of fixed mounted circuit breakers would offer a negligible cost savings over the draw out type breakers as specified, however approval to change to fixed mounted breakers type will be required to be obtained from Central Main Power prior to making any change.

Capital equipment costs for fixed mounted type switch gear equipment were solicited from several equipment suppliers and were found to be similar or higher when compared to the draw out type equipment originally specified.

The recommendations as outlined above resulted in a zero project savings as opposed to the $21,000 as recommended by the VE.

Recommendation (E-6) – Reduce Number of Spare Breakers

Reduce the number of spare breakers provided in the main switchgear.

Accepted with Comments

The quantity of spare breakers being provided in the main switchgear is required to feed both existing and future circuit loads. To meet current electrical redundancy standards, all existing plant loads should ultimately be transferred to the new switchgear which would enable the plant-wide loads to be fed from two sources ("double ended"). Though these spares are not immediately required, the installation of these circuit breakers under the current scope of work associated with the digester facility project will likely cost less than if the spare breaker equipment were installed in the future under separate contract.. Providing space in the switch gear for future circuit breakers to be installed under a separate contract in lieu of spare breakers is acceptable if LAWPCA agrees to have this capital improvement item deferred to a future contract..

The changes to reduce the number of Spare Breakers as listed above resulted in a net savings of $60,000.

Recommendation (E-12) – Delay Implementation of Cogeneration Facility

Delay the installation of the Cogeneration facility and appurtenances until additional funds are obtained thus improving project economics.

Accepted but Modified

The VE team estimates that the cost savings associated with delaying the installation of the cogeneration (cogen) system is approximately $4.2 million. CDM agrees that there would be significant savings associated with delaying the installation of the cogen to a later date, but we estimate the cost savings to be approximately $2.12 million.

Contrary to the VE recommendation, if the cogen system were removed from the project, the Gas Conditioning Building is still necessary to house the gas conditioning equipment, including the foam separator, sediment/drip trap, heat exchanger for moisture removal and biogas pressure boosters. With the delay of the cogen system, the only major item removed from the Gas Conditioning Building is the hydrogen sulfide removal vessel and associated piping. The total cost saving associated with the removal of this vessel is approximately $140,000.

The VE team also recommended the removal of the gas holder cover on the digested sludge storage tank. It is CDM's opinion that the gas holder cover is still necessary with or without the installation of the cogen system in order for the boiler system to operate efficiently and to prevent the boilers from cycling on and off. In general, since the biogas production from the digesters will not necessarily equal the rate of biogas consumption in the boilers, some biogas storage is required. Additionally, CDM does not recommend having an open digested sludge storage tank for safety and odor control reasons. As such, delaying the installation of the cogen system does not impact the design or cost associated with the gas holder cover.

It is CDM's further opinion that, irrespective of the schedule for cogen system installation, the following items should also remain in the current anaerobic digestion project:

- Hot water loop – Hot water loop needed between boiler, digester heat exchangers and Digester Equipment Building heating system. By delaying the cogen system, linear footage of hot water loop will decrease by approximately 1/3, but still be required.
- Natural gas line: Natural gas is still needed as supplemental fuel for the boiler system and as the pilot for the flare.
- Lighting, generator power and transformer for Gas Conditioning Building
- Biogas piping from digester to sludge storage tank: As CDM recommends that the gas holder cover remains in the anaerobic digestion project design, this piping is necessary to convey biogas from the digesters to the holding tank.

CDM estimates that the total cost for the Gas Conditioning Building, gas holder cover and items bulleted above to be approximately $2.12 million. Thus, by delaying the installation of the cogen system, the savings is estimated to be $2.12 million dollars as opposed to $4.27 million identified by the VE.