Nelson and Middle Basin Treatment Facilities Solids Handling Study – Executive Summary and Implementation Plan

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The scope of this study is to conduct an evaluation of advantages, disadvantages, and costs of alternatives to increase and improve the solids treatment processes of the Nelson Complex (NC) and Douglas L. Smith Middle Basin (DLSMB) Wastewater Treatment Facilities (WWTF's). The study was completed in stages, with the NC portion being evaluated first and the DLSMB evaluations completed later. An Executive Summary of the NC portion was delivered November 6, 2017. That document is now replaced with this combined document. Therefore, the conclusions from each facility are presented herein, followed by a combined implementation plan to optimize solids handling between the two facilities.

Nelson Complex Evaluation

The detailed analyses, including economic and non-economic criteria evaluations, on retained alternatives for the future solids processing facilities at the Nelson Complex (NC) Wastewater Treatment Facility (WWTF) were discussed at Workshop No. 2, conducted on August 7, 2017. Descriptions, preliminary sizing, and estimated capital and life-cycle costing were presented and cost-benefit scoring was performed. Minutes of both Workshop No. 1 - Screening of Alternatives and Workshop No. 2 - Analysis of Retained Alternatives are included in Appendix A. Two separate decision points were investigated:

1. Should the facility continue with landfilling of undigested waste solids, or transition to stabilization to achieve Class B Biosolids and beneficially utilize the material through agricultural land application?
2. If stabilization to achieve Class B biosolids is selected, what is the best long-term implementation strategy for the improvements to meet current solids loading from the facility, handle the hauled TWAS arriving from other facilities, provide FOG receiving capability, and accommodate the future increase in solids quantities that would result from biological nutrient removal (BNR) improvements at the NC.

Decision Point 1 – Landfill vs. Land Application

Continuing with landfilling was assumed to require no capital cost, and a range of cost per wet ton for landfill disposal was considered to evaluate potential impacts on changes in fees.

Implementing digestion for stabilization was assumed at the time of Workshop 2 to be a complete, single-phase project capable of handling all current and projected future loadings with all digesters in service (see workshop minutes for details of digester redundancy criteria) but excluding biogas utilization. Table 1 presents the life-cycle costing, non-economic benefit scores and benefit/cost scoring outcomes from Workshop No. 2.

Table 1
Economic and Non-Economic Criteria Evaluations of Landfill vs. Land Application

	Capital Cost	Annual Cost	NPV	Normalized NPV	Benefit Score	Benefit/Normalized NPV
Landfill	0	$1,744,000	$23,271,000	1.0	50.1	50.1
Digestion & Land Application	$29,844,000	$1,096,000	$44,468,000	1.9	65. 5	34.5

The Waste Management landfill alternative provides a higher benefit/cost score. However, the risk of the landfill turning away undigested sludge must also be considered. The long-term viability of landfilling is a significant risk and, as reflected in the non-economic benefit scoring, landfilling also provides minimal social or environmental benefits.

Risk and Redundancy Considerations

The original drivers for the Nelson and Middle Basin Treatment Facilities Solids Handling Study were related to addressing two factors:

- Increasing restrictions on the times during the week when sludge could be landfilled, as well as concerns that landfill disposal might eventually be prohibited.
- Failure of Digester No. 1 lid at the DLSMB WWTF in June 2016 due to apparent overloading from FOG deliveries, and the resulting inability to accept FOG from Johnson County and the metropolitan area, while repairs were being made.

Consequently, increasing redundancy in biosolids outlets and FOG acceptance capability is of critical importance in this evaluation.

The City of Shawnee has the authority through the Special Use Permit (SUP) process to restrict or prohibit biosolids disposal at the Waste Management Landfill, where the NC solids are currently hauled. This landfill is the only available landfill within a days drive, and there are no backup landfills available for biosolids disposal. Issues with odors from the landfill operation have been a source of concern for the City. In fact, the SUP approved by the City Council on September 11, 2017 is for a term of only one year, with a six-month review deadline of March 2018. Further, the SUP stipulates that biosolids only be accepted at the landfill between the hours of 10 am and 3 pm. This requirement causes significant operational problems in managing dewatering and accumulating trailers filled with dewatered sludge. In addition, it has become increasingly difficult for Waste Management to provide drivers for hauling sludge, prompting JCW to contract with Midwest Injection for hauling services, at a price almost twice that of Waste Management's. While the SUP also allows for disposal from midnight to 4 am, this option is difficult to implement. Additionally, issues with odors from the landfill operation, as presented in the next section, indicate that the risk of relying on the landfill as the only biosolids disposal option is high.

The projected FOG quantities developed as part of this evaluation indicate that the DLSMB facility may have been receiving the entire Kansas City metropolitan area's FOG production at the time of the DLSMB digester lid failure in June 2016. At some point since the DLSMB FOG facilities went

online in 2011, all other known local outlets had apparently ceased accepting FOG. Based on discussions in the Regional Biosolids Meetings (a group of metropolitan area sewer utility representatives founded in part in response to the concerns about the availability of landfill disposal and which has begun addressing both biosolids use and FOG disposal), it appears unlikely that other outlets for FOG will be available in the near term. As a result of both the need in Johnson County and the metropolitan area for FOG disposal locations, and the benefits associated with accepting FOG at JCW facilities, JCW is interested in enhancing its FOG receiving reliability and perhaps also in expanding its FOG receiving capacity. However, FOG receiving cannot occur at the NC without adding sludge stabilization (i.e. anaerobic digestion). Therefore, the current facilities at NC fail to provide a key objective of the study, namely to provide increased reliability and redundancy in accepting the FOG generated within the JCW service area.

In conclusion, there are very important redundancy and reliability considerations that remain unaddressed if the current landfilling processes are retained at the Nelson Complex.

Social Impacts

The non-monetary screening criteria used for Workshop No. 2 included a “Social Impacts” criterion. This criterion included the following considerations: “How well does the alternative prevent off-site impacts for traffic, noise, odors, visual, etc.”. In the last two years, odor complaints from the operations at the Waste Management Landfill at I-435 and Holliday Drive in Shawnee have escalated significantly. In response, the City of Shawnee hired the firm of Blackstone Environmental to evaluate the causes and potential solutions to the odor problems at the landfill. Blackstone prepared reports in two phases, one dated September 21, 2016 and the other March 28, 2017. The Blackstone reports identified the following odor sources at the landfill:

- Management of the Active Face
- Composting Operations
- Landfill Gas Collection System
- Biosolids Disposal

The Blackstone reports do not identify which odor source is most predominant, but rather identify possible improvements in each area that could reduce odors. It is likely that the NC WWTF only contributes about 10% of the total biosolids accepted at the landfill. However, the Blackstone report recommends cessation of acceptance of sludges from another sewer utility for 180 days if current odor abatement efforts at the utility are unsuccessful. While JCW was not specifically mentioned in the report, this is an area of concern as the potential ban could be expanded to most or all biosolids disposal.

An uptick in landfill odor complaints to the City in August of 2017 also led to some discussions regarding the viability of sludge disposal at the landfill. As noted in the Blackstone report, landfill operations are inherently subject to odor complaints, so it is likely complaints will continue and landfilling of sludges will remain a focus of concern. The City is the primary recipient of odor complaints and has the authority to impose requirements, including cessation of acceptance of sludges, at any time through the SUP issued by the City to the landfill. It is also worth noting that the current landfill biosolids disposal practice requires that undigested biosolids be hauled through residential areas. All of these considerations point to the notion that the long-term acceptability of landfilling undigested sludges at the Waste Management landfill is at best uncertain.

By comparison, the social impacts of the current JCW land application program of DLSMB biosolids have been minimal, with only two complaints in recent years.

In conclusion, there are significant positive social impacts from shifting away from landfill disposal.

Environmental Impacts

Landfilling of biosolids does increase the volume of landfill gas by the continued anaerobic decomposition of biosolids in the landfill. This gas is recovered at the Waste Management landfill, and is "wheeled" to the local gas utility in volumes sufficient to heat 5,000 homes. Consequently, there is an environmental benefit to landfilling of biosolids. However, there are challenges in recovering landfill gas, and as noted in the previous section, landfill emissions is a potential source of odors.

Land application of biosolids provides for beneficial reuse of the biosolids with the recycling of critical nutrients into the food chain and greatly improves soil structure. This material is so valued in the agricultural community that Midwest Injection, the contract land application provider for JCW, indicates that the current biosolids production from the DLSMB facility can only satisfy the demand for about 1,000 acres of farmland, but Midwest has an additional 3,000 acres available for land application. Additionally, studies have been conducted over the years demonstrating that land application of Class B biosolids in accordance with EPA 503 sludge regulations is safe for the environment. JCW has remained in compliance with these regulations under the current land application program for the DLSMB WWTF.

In conclusion, there are significant environmental benefits to land application of biosolids over the current practice of landfilling biosolids.

Landfill vs. Land Application Recommendation

The availability of two outlets for biosolids from the NC (land application as primary and landfilling as a backup only) would mitigate the external risks to managing biosolids. The conclusion of Workshop No. 2 was to resume digestion at the NC to:

1. Provide alternatives to landfilling of the solids due to the increasing risk of these solids not being acceptable at the landfill in the future, coupled with the social impacts of hauling and landfilling undigested sludge, and
2. Provide the desired level of reliability and redundancy in JCW's biosolids and FOG processing operations.

Therefore, it is recommended that JCW initiate steps to resume anaerobic digestion at the Nelson Complex to allow for agricultural land application of the biosolids produced.

Decision Point 2 – Stabilization Alternatives

With the recommendation to provide an alternative to landfill disposal of undigested biosolids through the implementation of stabilization to achieve Class B biosolids for land application, the next decision is to select the best long-term implementation strategy to achieve that goal. Long-term goals established for the alternatives are that the improvements must meet current solids loading from the facility, handle all hauled TWAS arriving from other facilities, provide FOG receiving capability, and also accommodate the future increase in solids quantities that would result from future BNR improvements at the NC. All solids streams, with the exception of FOG receiving, must be able to be stabilized with one digester out of service. All alternatives included the complete facilities required for receiving and blending the various solids streams,

anaerobic digestion, and post-digestion holding prior to dewatering. Alternatives for beneficial utilization of the gas generated by the digestion process were also evaluated.

Numerous alternatives were screened (reference Workshop No. 1 minutes in Appendix A), and the stabilization alternatives retained for detailed evaluation included conventional mesophilic digestion and a scenario that would enhance mesophilic digestion with either acid-gas phased digestion, post-aerobic-digestion (PAD) or both. However, in development of the acid-gas and PAD concepts, it was determined that they required mores structures, more equipment to operate and maintain, and made poor utilization of the limited space on the site. As a result, those concepts were discarded and cost estimating not completed (reference Workshop No. 2 minutes in Appendix A). To create a second alternative (D2) for consideration, a mesophilic variation with a much smaller site footprint than the base alternative (D1) was developed. Although Alternative D2 included one more digester (4 total) than Alternative D1 (3 total), the layout was more easily optimized to reduce the overall site footprint. Additionally, the D2 alternative results in more volume for active digestion and therefore greater capacity, potential for additional volatile solids reduction (VSR) and additional FOG receiving capacity if one digester is out of service. Table 2 presents the life cycle and benefit/cost scoring outcomes.

Table 2
*Economic and Non-Economic Criteria Evaluations of Digestion Alternatives**

	Capital Cost	Annual Cost	NPV	Normalized NPV	Benefit Score	Benefit/Normalized NPV
D1 – 3 mesophilic digesters	$29,844,000	$1,096,000	$44,468,000	1.0	43.1	43.1
D2 – 4 mesophilic digesters	$38,674,000	$1,096,000 [1]	$53,298,000	1.2	72.5	60.4

[1] O&M cost increase for 4th digester (operated as variable volume secondary digester) is offset by eliminating the O&M of separate post-digestion storage tanks (Digesters 1 and 2)

*These costs include ELA and contingency factors

Alternative D2 scored much higher in non-economic criteria due to the improved utilization of the limited space on the site, the simplicity of operation, and the capacity, redundancy and reliability benefits. The three-digester layout of Alternative D1 required retaining existing Digesters No. 1 and 2 for holding, and demolition of existing liquid treatment processes to construct the new 3rd digester. In contrast, the four-digester compact “cloverleaf” configuration in Alternative D2 would eventually demolish existing digester Nos. 1 and 2 and not infringe on space currently used by the liquid treatment processes. In this case, the benefit score greatly outweighs the higher total capital cost of the D2 alternative and implementation of the D2 alternative is recommended.

Recommended Improvements

It was concluded in Workshop No. 2 that resumption of digestion would be implemented in a phased approach, with minimal initial redundancy, working toward an ultimate plan of 4 digesters in the consolidated “cloverleaf” site layout footprint as developed for Alternative D2. Receiving facilities for hauled TWAS and FOG would be preferred to be incorporated into the initial phase, but gas utilization (beyond heating digesters) would be delayed until a later phase. Another conclusion of Workshop No. 2 was that it is not clear how Kansas Gas Service (KGS) will respond to wheeling of cleaned gas as a utilization alternative, as they do not have other clients that wheel. For the purposes of this implementation/phasing plan, it is assumed cogeneration will be used to

be consistent with other JCW facilities, but this should be re- evaluated when future phases addressing biogas utilization are implemented.

A follow-up Workshop ("Cliff's Notes Version") was conducted on September 1, 2017. In that Workshop, a three-phase implementation concept was presented, as generally described in Table 3, and the potential for smaller steps for Phase 1 was investigated. In Workshop No. 5 on March 5, 2018, it was noted that an interim method of unloading trucked TWAS and transferring it to the pre-digestion blending tanks would be required if only Phase 1, Step A was completed. In order to implement FOG receiving at NC, all steps of Phase 1 must be in place.

While the phased implementation does ultimately result in a higher capital cost, with a small percentage (approximately $2M, or 5%) for rehabilitation of existing Digester Nos. 1 and 2, and subsequent demolition of these digesters for a future digester in Phase 3, the phased implementation is more suitable for coordination with JCW's financial plan and for the long-term coordination with the NC's likely future conversion to BNR.

Table 3
*Implementation Phasing Concept**

Phase	Description	Capital Cost (2017 dollars)
1 Step A	Rehabilitate Digester 3 and convert existing Sludge Holding Tanks to pre-digestion blending ($5.6M); Add temporary TWAS unloading ($0.5M).	$6.1M
1 Step B	Rehabilitate Digester 4 and convert Digesters 1&2 to post-digestion storage ($6.4M);Allowance for miscellaneous reliability improvements ($2.0M)	$8.4M
1 Step C	Construct FOG Receiving/TWAS Unloading	$3.75M
2	Construct 3rd Digester (Digester 5) and Gas Utilization Facilities and Demolish Digesters 1&2	$24.1M
3	Construct 4th Digester (Digester 6)	$12.3M
	Cumulative Cost	**$54.7M**

***These costs include ELA and contingency factors**

The subsequent sections of the plan will address the details of the individual phases. The possible re-use of existing facilities, including the existing solids and incineration buildings, will be evaluated in the design memorandum phase.

Phase 1 Resuming Digestion Plus FOG Receiving/TWAS Unloading

A complete Phase 1 (Steps A thru C) is recommended for implementation. While this phase has limited redundancy for digestion, it does allow JCW to divert biosolids from the landfill to land application. This phase will provide capacity for NC's current biosolids, all future TWAS, and some metro area FOG solids quantities. The exact amount of FOG that can be accepted at these facilities will be dependent on the actual amount of TWAS hauled to the site as well as the characteristics of the FOG. As presented in Workshop 2, to provide stable digestion the quantity of FOG that can be accepted is limited by the quantity of other sludges available for digestion. However, if one digester is out of service, the required minimum solids retention time (SRT) can only be achieved if sludge loading is limited to the current sludge production for the NC facility and the current

TWAS receiving quantities. No FOG could be accepted and some TWAS may need to be diverted to DLSMB to maintain the SRT's required for land application. Alternatively, SRT could be allowed to fall below the requirements and the biosolids would then be hauled to the landfill as a backup operation. The attached Figure 1 presents a proposed site-plan for the recommended improvements.

The cost analysis of the complete Phase 1 presented in Table 4 indicates that Phase 1 represents the optimum cost benefit in the impact on JCW user charge rates, while providing significant capacity, redundancy and reliability, as outlined above. It is also recommended that an allowance be added for any additional rehabilitation and reliability enhancements to the existing solids facilities. For example, at the solids dewatering facility, the existing conveyor for the dewatered solids represents a single point of failure. An allowance of $2 million has been added to Phase 1 to cover such reliability improvements. Details on the Phase 1 scope are presented in the paragraphs that follow Table 4.

Table 4
Phase 1 Resuming Digestion Plus FOG and TWAS Receiving Facility, Cost Summary and Rate Impact

Capital Costs:	
Rehab Dig 3 & 4	$ 9,200,000
Rehab small holding tanks for pre-digestion blending	$ 700,000
Rehab Digester 1 and 2 for post-digestion storage	$ 2,100,000
FOG Receiving/TWAS Unloading	$ 3,750,000
Allowance for Misc. Reliability Improvements	$ 2,000,000
Total Project Cost	**$ 17,750,000**
20 Year at 2.3 % Bond Debt Service/Year	**$ 1,310,000**
Additional O&M Cost/yr:	
Digestion	$ 540,000
FOG Receiving	$ 180,000
Cost Savings/Revenue:	
Disposal Cost Savings[2]	($ 570,000)
FOG Tipping Fees[1]	($ 600,000)
Net Annual Cost	$ 860,000
Impact on Revenue Requirements	0.65%
($0.86 M vs 2020 Revenue of $131 M)	(after JCW user charge rates)

Notes: All costs presented in 2017 dollars
Excludes $0.5M for temporary TWAS unloading that was included in Table 3, as temporary facilities would not be required if a complete Phase 1 was implemented
[1]FOG tipping fees were $0.07/gal
[2]Disposal cost savings calculated as difference between landfilling undigested sludge ($42/wet ton) and land applied digested sludge ($21.64/wet ton)

Existing Anaerobic Digester Complex Conversion and Ancillary Equipment

This portion of the phase will include conversion and rehabilitation of the existing large (80-ft dia) Digester Nos. 3 and 4 to mesophilic pancake-type anaerobic digesters that will provide an SRT required for Class B biosolids (minimum 15 days), installation of all new ancillary anaerobic digestion equipment including new covers, mixing equipment (Digester 3 only), hot water boilers, gas collection equipment and waste gas flare. The existing small Digester Nos. 1 and 2 will be converted to covered and mixed storage tanks to provide approximately 3 days storage of digested sludge before dewatering. The existing sludge holding tanks will be modified to provide for blending and equalization of sludges to be fed to Digester Nos. 3 and 4 (tag names 1 and 2 respectively).

FOG Receiving/TWAS Unloading Facility

Restaurant and industrial FOG waste from across the Kansas City metropolitan area is currently hauled to the DLSMB WWTF. This evaluation analyzed the possibility of receiving FOG at the NC WWTF as well. Additionally, the analysis determined a more robust TWAS unloading facility is needed to accommodate sludges hauled from the New Century Air Center (NCAC) and Blue River Main (BRM1) WWTF's. A heated and mixed FOG waste receiving station will be constructed to temporarily store the FOG before it is fed directly to the digesters at a relatively low and constant rate. The FOG receiving station will consist of a truck dump station and wash down area, carbon odor control system, electrical room, heat exchangers, debris removal, storage tanks and associated pumps. The tanks could be heated from the digester hot water system using a hot water circulation pump and radiant heat piping installed in the walls of the storage tanks or using liquid to liquid heat exchangers. Mixers will be installed in each tank to minimize solids settling and material stratification. In addition, a TWAS unloading area will be included within the FOG receiving facility with pumps to enable the material to be transferred to the existing sludge storage tanks for equalization and blending. Several alternate locations were discussed in Workshop No. 2 for the location of the FOG receiving/TWAS unloading facility. A final determination of the location of the facility should be evaluated in the pre-design phase in coordination with the upcoming Nelson Complex WWTF Facility Plan Study.

Phase 2 Enhanced Digestion Plus Biogas Utilization

This phase is recommended for implementation in coordination with the future conversion of the NC WWTF to BNR, currently anticipated to be complete and online in 2028. This phase will provide capacity for NC BNR biosolids, future TWAS, and a portion of metro area FOG solids quantities. However, if one digester is out of service, there would not be sufficient capacity for FOG, but there would be capacity for NC BNR and all TWAS future solids quantities. The attached Figure 2 presents a proposed site-plan for the recommended improvements.

Construct Anaerobic Digester No. 5 and Ancillary Equipment

This phase will include construction of an 80-foot diameter anaerobic Digester No. 5 matching the size of the rehabilitated Digester Nos. 3 and 4, all operating as mesophilic pancake-type anaerobic digesters and sized to provide an SRT required for Class B biosolids (minimum 15 days) in a compact "cloverleaf" configuration. The existing small Digester Nos. 1 and 2 will be demolished to make room for Digester No. 5. Digester 5 will operate as a variable volume, secondary digester, to provide the post-digestion storage volume for dewatering downtime that was previously provided by Digesters No. 1 and No. 2.

Gas Utilization System

As note previously, for the purposes of this implementation plan, it is assumed cogeneration would be used to be consistent with other JCW facilities, but this should be re-evaluated in the Phase 2 pre-design study. Two 600 KW (nominal) generators and CHP packages are proposed for this phase. To level out electricity generation with the variable gas production from the digesters, a pneumatic membrane storage vessel would provide short-term gas storage. To minimize visual impacts, the storage vessel would be an appropriate color or possess a similar aesthetic attribute and will be located within the NC site to minimize off-site visibility. Ancillary equipment would include an exhaust heat recovery heat exchanger and a jacket water heat recovery heat exchanger that is tied into the digester hot water heating loop. A remote radiator to remove excess heat during warmer weather would also be installed. To protect the engine and minimize maintenance, gas cleaning equipment to remove hydrogen sulfide, moisture and siloxanes would be installed. Parallel switchgear would be installed to enable plant-wide power grid connection or isolation as necessary. The engine generator, heat exchangers, gas cleaning equipment, and switchgear would be installed within a new building to facilitate equipment maintenance and reduce noise emissions.

Project Cost and Schedule

Estimated total project costs for Phase 2 are presented in Table 5. It is recommended that this phase be included in, or coordinated with, the future conversion of the NC WWTF to BNR.

Table 5
Phase 2 Enhanced Digestion Plus Biogas Utilization, Cost Summary

Item	Cost
SCOPE OF PROJECT	
Construct 3rd Digester (Digester 5)	$ 12,234,000
Demolish Digesters 1&2	$ 589,000
Construct Cogeneration Facilities	$ 11,263,000
Total Project Costs	**$ 24,086,000**

Note: All costs presented in 2017 dollars

Phase 3 Redundancy

This phase is recommended for implementation at such time it is desired to have full redundancy for digestion and FOG acceptance. This phase will provide capacity for NC BNR, TWAS future, and some portion of metro area FOG solids quantities. If one digester is out of service, there would be full capacity for this quantity of FOG, as well as for NC BNR and future TWAS solids quantities. The attached Figure No. 3 presents a proposed site-plan for the recommended improvements.

Construct Anaerobic Digester No. 6 and Ancillary Equipment

This phase will include construction of an 80-foot diameter anaerobic Digester No. 6 matching the size of Digester Nos. 3, 4, and 5, all operating as mesophilic pancake-type anaerobic digesters sized to provide SRT required for Class B biosolids (minimum 15 days), all in a compact “cloverleaf” configuration. Digester 6 would normally operate as a primary digester, with

previously constructed Digester 5 operating as the variable volume secondary digester. If determined during the pre-design phase, Digester No. 5 could be provided with equipment to operate as a Post Aerobic Digester to provide side-stream and struvite treatment and additional volatile solids destruction.

Project Cost and Schedule

Estimated total project costs for Phase 3 are detailed in Table 6. A detailed schedule for this phase is not provided, but it is recommended that this phase be included at such time it is desired to have adequate redundancy for digestion and FOG acceptance.

Table 6
Phase 3 Redundancy, Cost Summary

Item	Cost
SCOPE OF PROJECT	
Construct 4th Digester (Digester 6)	$ 12,234,000
Total Project Costs	**$ 12,234,000**

Note: All costs presented in 2017 dollars

Middle Basin Evaluation

The detailed analyses, including economic and non-economic criteria evaluations, on retained alternatives for the future solids processing facilities at the Douglas L. Smith Middle Basin (DLSMB) WWTF were discussed at Workshop No. 4/5, conducted on March 5, 2018. Descriptions, preliminary sizing, and estimated capital costing were presented. Minutes of both Workshop No. 3 - Screening of Alternatives and Workshop No. 4 - Analysis of Retained Alternatives are included in Appendix B. One decision point was investigated:

1. Are current operating conditions with respect to FOG acceptance and digestion capacity acceptable and sustainable? If current operating conditions are outside of a sustainable range, what steps should be taken to bring operations to an acceptable condition?

Decision Point – Acceptability of Current Operating Conditions

The JCW DLSMB WWTF currently produces 35,000 gpd primary sludge and 30,000 gpd TWAS onsite under annual average conditions. The facility also currently accepts approximately 18,000 gpd of FOG. Although the primary sludge and TWAS are well defined, the effect of the FOG stream is difficult to quantify.

Due to a limited data set and high level of concentration and volume variability, the impact of FOG on the digestion capabilities of the existing facilities is challenging to identify. The FOG received by the facility is a mixture of restaurant (brown grease) and industrial (yellow grease) waste. According to a recent study performed by Black and Veatch, it is believed that 6,000 gpd of industrial FOG and 12,000 gpd of restaurant FOG is being processed.

As an industry best practice, it is suggested that the loading from FOG should be no greater than 30% of the total COD load to the digester. While it has been observed in specific situations and laboratory settings that systems can operate at 50% loading from FOG, operations at this condition are challenging and not recommended, especially when the FOG strength is not well defined or is highly variable. Based on the limited data available, it is believed that COD concentration of the incoming blended FOG averages approximately 173,000 mg/L (see page 14 of Appendix B). At this concentration, DLSMB digesters are potentially receiving 54% of their COD load from FOG. The recommended quantity of FOG at this strength is approximately 7,000 gpd in order to remain within the 30% rule of thumb.

Risk and Redundancy Considerations

An original driver for the DLSMB WWTF portion of the Solids Handling Study was related to addressing failure of Digester No. 1 cover at the DLSMB WWTF in June 2016 and the resulting inability to accept FOG from Johnson County and the metro area, while repairs were being made.

Under current operating conditions, it is believed that the DLSMB facility is operating well over the 30% load from FOG industry best practice. Due to the lack of redundancy at the facility, if a digester requires repairs that take it offline, the facility will be required to cease FOG and trucked-in TWAS acceptance. Lack of redundancy in the past has led to loss of primary digestion capacity and resulted in cessation of FOG receiving. This impacts the entire metropolitan area, as the DLSMB WWTF at times has become the only FOG receiving facility.

In conclusion, important redundancy and reliability considerations remain unaddressed if the current operating conditions are continued.

Recommendations to Achieve Acceptable and Sustainable Operations

As part of a long-term effort to achieve operational conditions that are both acceptable and sustainable, three phases of an Implementation Plan to address operational and capital improvements have been identified to optimize the DLSMB WWTF biosolids handling and FOG acceptance capability based on concentration and quantity of the hauled material:

1. Phase 1-Begin FOG Program Development to enhance management of this revenue generating waste stream and implement stability improvements
2. Phase 2-Construct FOG receiving at Nelson (i.e. Nelson Complex Recommended Improvements, Phase 1-C) to increase redundancy
3. Phase 3-Construct additional digestion capacity at DLSMB and optimize TWAS utilization with TWAS receiving and equalization at the DLSMB WWTF to increase operational stability

Recommended Improvements

It was concluded in Workshop No. 4 that digestion of FOG would continue at DLSMB, and steps would be taken to better characterize the incoming FOG material and create a robust FOG acceptance policy based on the material's effect on receiving capacity during Phase 1 of the implementation Plan. Phase 2 of the DLSMB improvements for redundancy do not occur at DLSMB, as receiving facilities for hauled TWAS and FOG will be added to the Nelson complex to support FOG acceptance redundancy and off-load the DLSMB facility. The final phase involves optimizing the acceptance of both FOG and hauled TWAS between the DLSMB and Nelson facilities with additional capital improvements occurring at DLSMB to facilitate the optimization.

Table 7
DLSMB Implementation Phasing Concept

Phase	Description	Cost (2017 dollars)
1	FOG Policy Development and Stability Improvements [1]	$0.8M
2	FOG Receiving at Nelson Complex (reference Nelson Portion)	$0 at DLSMB
3	TWAS Equalization, Additional Primary Digester, new Post-Digestion Storage and gas-holding	$10.0M
	Cumulative Cost	**$10.8M**

[1] Excludes Costs of Stability Improvements identified by Black and Veatch

The subsequent sections of the plan will address the details of the individual phases. The attached Figure No. 4 presents a proposed site-plan for the recommended improvements.

Phase 1 FOG Policy Development

It is necessary to have a firm grasp on incoming FOG characteristics in order to quantify digester loading and thoroughly understand the impact on digester performance of those loading conditions.

Phase 1 will include implementation of a detailed sampling method, randomized testing sufficient to develop an accurate representation of FOG coming to the facility, and the

development of a policy that will give JCW relative control over the quantity, characteristics, and service area of the FOG being processed at DLSMB. As additional FOG receiving improvements are implemented (such as the ability to receive FOG at Nelson), the FOG policy will require updating so that the allocation of FOG to the two facilities can be established based on FOG strength and nutrient characterization, plant-generated solids at each available receiving facility, distribution of hauled TWAS to each available receiving facility, and gas generation and utilization at each facility.

Examples of FOG and TWAS optimization scenarios were presented at the March 20, 2018 follow-up briefing after the workshop March 5th. A simplified version of those scenarios is provided in Figure 1 below.

As previously discussed, in some situations addition of TWAS to the sludge being digested can balance the load added by FOG. The data used for the figure assumes that 30% of the COD load being digested can come from FOG. In this figure, a fixed amount of TWAS will be distributed to either DLSMB or the Nelson Complex, creating an operational zone in which the greatest total quantity of FOG can be accepted between the two facilities before experiencing violations of other loading criteria. The additional data collected through implementation of the FOG policy would allow a tool such as this to be refined so that it is available for decision making when FOG receiving at Nelson is available and optimization between the two facilities is necessary. The optimal hauled TWAS and FOG distribution within the operational zone will will also need to factor other priorities for FOG use, such as gas utilization.

To interpret this graph:

- Assume TWAS quantity to be hauled is fixed, with a percentage of available hauled TWAS being sent to either facility as listed on the x-axis
- The orange and blue curves show the consequential FOG that can be accepted at DLSMB or the Nelson Complex, respectively. The grey curve is the sum of FOG being accepted at both facilities.
- The green bars show the endpoints of distribution possibilities which will achieve the maximum total FOG accepted.

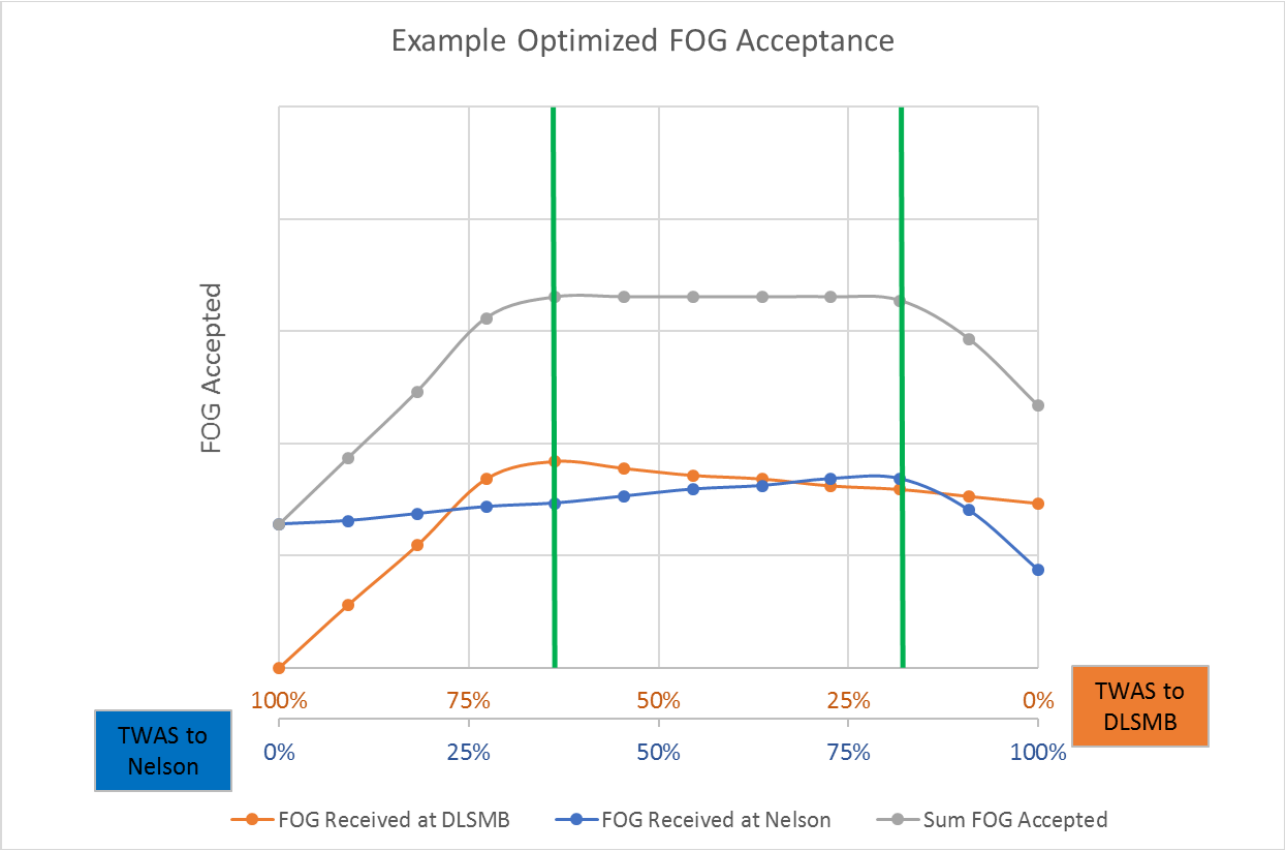

Figure 1
Example Optimized FOG Acceptance Curves

FOG Sampling and Testing

Phase 1 would involve recommendations for sample collection from every FOG hauling vehicle that arrives at DLSMB, similar to the suggestion provided in the Black and Veatch April 2017 FOG Acceptance Memorandum. However, to prevent overloading the laboratory with FOG testing, it is suggested that samples be tested at random for a minimum of COD and TS/VS rather than testing every sample. The policy should address sample handling procedures, such as where to sample, who collects and identifies the sample, how it is stored and tracked, how and when it is disposed, etc.

FOG Acceptance Structure and Rates

It is suggested that JCW conduct a formal FOG acceptance fee evaluation, including cost of service and market conditions considerations. A market conditions study would evaluate the existing tolerance by haulers and producers for FOG handling within the Johnson County metro area, as well as surrounding areas, in order to evaluate the demand for additional FOG acceptance capacity as well as the tolerance for FOG handling rate increases. The intent of the study would be to guide the rate setting structure for future FOG acceptance and lead the policy of FOG acceptance at all JCW facilities. At this time, it is not possible to accept all metro area produced FOG, so a prioritization methodology needs to be developed to optimize acceptance based on source (including source's location, either inside or outside of county) and both the quantity and strength of that source's material.

A tiered rate structure could be based on location of the FOG source:

- Inside Johnson Co., “Low Strength” range
- Inside Johnson Co., “High Strength” range
- Outside Johnson Co., “Low Strength” range
- Outside Johnson Co., “High Strength” range

FOG acceptance at DLSMB is currently on a first come first serve basis. However, registering haulers and assigning them into the tier structure may cut down on some infrequent contributors. Registering could include registering for up to a max quantity as part of the process.

The final policy implemented should address potential political concerns about prioritizing FOG generated in Johnson Co. over out-of-county FOG since FOG improvements were paid for by JCW ratepayers. There may be a preference for not adversely affecting business economic viability within Johnson Co.

Other DLSMB Digestion Improvements that may occur concurrent with Phase 1

Documentation from Black & Veatch to JCW (dated May 7, 2018) provides recommended operational/capital improvements to the solids and FOG processing facilities at Middle Basin to make the current FOG acceptance levels more stable. The primary action item in that document is a sodium bicarbonate feed system to add alkalinity and control digester pH. Several lower priority improvements recommended by Black & Veatch focus on addressing TWAS thickness inconsistencies. Recommendations from Black & Veatch are not reproduced in this document, however an additional opportunity to address TWAS thickness inconsistencies is present (recuperative thickening) that was not included in the Black & Veatch list.

Piping, valving and SOPs for recuperative thickening exist, but the SOP requires significant operator attention. Recuperative thickening also requires that excess capacity be reliably available at the existing centrifuge thickening process. Recuperative thickening provides operations with a flexible tool for removing excess water from the digestion process and increasing digester HRT/SRT. Excess water could be introduced from multiple sources, such as thin FOG loads or inconsistent performance from primary sludge or WAS thickening. Capital investment to make recuperative thickening more automated should be considered at such time as thickening equipment at DLSMB is operating reliably with excess capacity/redundancy, and would include the following:

- Replace throttling pinch valve with progressing cavity pump on VFD to allow diversion of digested sludge to recuperative thickening without taking a BFP and corresponding forcemain offline.
- Modify SCADA controls to incorporate new pump and adjust setpoints and logic to achieve automated operation of the recuperative thickening sequence.

Phase 2 FOG Receiving at the Nelson Complex

This improvement is recommended for implementation in coordination with the phased rehabilitation of the NC WWTF anaerobic digesters. Once digestion has resumed with a minimum of two (2) primary digesters, and the characteristics of FOG coming to JCW are better defined, FOG receiving can begin at the NC WWTF.

With FOG receiving capabilities in-place at the NC WWTF, the ratio of digester feed COD from FOG at both WWTF’s can be improved and FOG loads that do not optimize gas production for cogeneration at DLSMB can be diverted to the NC WWTF. When FOG receiving at the NC WWTF goes online, the FOG policy developed in Phase 1 would require updating to reflect the new

capacity. Data collected during Phase 1 sampling and policy implementation will be valuable for the refinement of the policy and for optimizing the balancing of FOG utilization between the facilities.

Phase 3 Capacity, Redundancy and TWAS Optimization

Conversion of Existing Secondary Digester to Primary Digestion and new Digested Sludge Storage

Capital improvements to be considered in this phase include an addition of digestion capacity and primary digester redundancy, through the conversion of the existing secondary digester to a primary digester. In order to complete the conversion, additional digested sludge storage will be necessary to replace the function of the existing secondary digester, and could include the construction of new sludge storage with gas holding capabilities at the site of the existing gas storage bubble. The existing gas storage bubble is nearing the end of its useful life and therefore could be replaced with a storage bubble that is located on top of a sludge storage tank.

The site is space limited, and taking this step provides the necessary storage space to allow for conversion of the secondary digester into a primary without significantly encroaching on the existing footprint of the site. The replacement of the bubble with combined sludge/gas storage could occur prior to the conversion of the secondary digester if replacement of the existing bubble is a higher priority, with the interim condition resulting in additional digested sludge storage. The gas bubble enables the site to minimize the amount of natural gas that is blended with digester gas to fire the cogen engines. During construction, and while gas storage is not available, it could be necessary to either set the blend ratio at a constant percentage based on reliable digester gas production and flare the rest or to fire the cogen engines on natural gas only and flare digester gas.

Costs shown in Table 8 for this step are based on:

- Significant piping modifications to feed Digester 2 as a primary.
- Replacement of secondary digester cover with fixed cover and new gas bubble cover on new post-digestion storage.
- Minimum digested sludge storage volume of 280,000 gal with minimum variable volume of 139,000 gal for post digestion storage; 55-ft dia, 16-ft deep minimum, 8-ft operating range (with dewatering capacity and dewatering equipment redundancy at DLSMB, reduction of operating volume to one day was considered feasible)
- Jet mixing in the digested sludge storage for mixing solids that average 2-3%.
- Gravity transfer to new digested sludge holding tank, new dewatering feed pumps and piping, including new dedicated forcemain to recuperative thickening.
- Relocation of electrical service ductbank currently located under existing gas bubble

Improvements for Receiving, Equalizing and Blending hauled TWAS at DLSMB

After conversion of the existing secondary digester to an additional primary digester, additional capacity will be available for solids handling. However, accepting additional FOG is not recommended unless additional WWTF-generated solids are available to keep the digester feed % COD from FOG within industry best practices ratio. Therefore, to increase FOG acceptance, hauled TWAS from off-site would also need to be enabled, which would require additional improvements to better facilitate hauled TWAS.

Hauled TWAS has historically been unloaded into the TWAS hopper downstream of the plant's thickening centrifuges, and from there fed directly to the primary digesters. With the very small volume of the existing TWAS hopper, unloading tankers of hauled TWAS results in short duration, high feed rates to the digesters. This type of slug feed to the digesters can be disruptive to operations. Therefore, improvements to provide equalization of the hauled TWAS to enable more even metering into the

digesters is recommended, and to blend the plant-generated TWAS with the hauled TWAS prior to introduction into the digesters.

Costs shown in Table 8 are based on:

- Re-purposing half of one of the existing UWAS tanks to be TWAS equalization. Two 300,000 gallon UWAS tanks exist now, keeping 450,000 gal for UWAS (two basins, one @ 300,000 gallons and one @ 150,000 gallons subdivided for UWAS). The remaining 150,000-gallon basin will be subdivided into two 75,000-gallon TWAS storage basins. Provides 2.5 days of equalization at an assumed combined TWAS flow of 58,000 gpd (30,000 gpd plant-generated plus up to 140,000 gal/week hauled TWAS).
- Assumes hauled TWAS would be delivered 5 days per week (28,000 gpd Monday-Friday and none on weekends) and unloading into the existing TWAS unloading station at the TWAS hopper downstream of existing centrifuge thickening.
- Assumes heavy duty mechanical mixers in the TWAS storage basins for mixing solids that average 4% but could range higher.
- Assumes existing pumps from plant-generated TWAS hopper would be used to transfer to new TWAS storage basins through new piping
- Provides a new digester feed pump station and piping to feed the blended and equalized TWAS to the digesters at a slow, consistent, rate (~40 gpm).

Table 8
Phase 3 Cost Breakdown

Item	Cost
SCOPE OF PROJECT	
TWAS Equalization	$1,500,000
Convert Digester 2 to Primary Digester and Construct new Post-Digestion Storage and Gas Holding	$8,500,000
Total Phase 3 Project Costs	**$10,000,000**

Note: All costs presented in 2017 dollars

Comprehensive Nelson and Middle Basin Treatment Facilities Solids Handling Improvements – Implementation Plan

This section combines the recommended improvements for both facilities into an integrated implementation plan for solids handling. Progressing in stages allows for flexibility and minimizes initial capital investment and potential rate impacts. Both operational/administrative and capital expenditure recommendations are included to provide a plan that guides the facilities through a gradual transition from their current operating condition to the desired ultimate endpoints where adequate capacity and redundancy are provided and risk is reasonably mitigated.

Stage I – Resumption of Anaerobic Digestion at Nelson Complex and FOG Policy Development for DLSMB

Partial implementation of Phase 1, specifically Phase 1-A, is planned for the first stage of improvements at the NC WWTF. Phase 1 – Step A includes rehabilitation of Digester 3 into an anaerobic digester, converting existing small sludge holding tanks to pre-digestion blending, and adding temporary TWAS unloading to receive hauled TWAS and transfer it into the pre-digestion blending tanks. Digester 4 is currently serving as sludge storage and would remain as sludge storage, but instead as post-digestion sludge storage between anaerobic digestion and dewatering.

As described in greater detail in the DLSMB portion of the memorandum, Phase 1 at that facility is implementation of a rigorous FOG policy and sampling protocol. Consideration of providing a more formal structure for FOG acceptance and assigning new rates to that structure is recommended. The FOG policy will require updating as additional stages of the solids handling improvements are implemented.

In addition to the short-term recommendations from Black & Veatch for DLSMB (not reproduced in this document), implementation of recuperative thickening enhancements to address TWAS thickness inconsistencies is recommended.

Project schedule(s) are shown in Table 9.

Stage II – Nelson Complex Digestion Redundancy and FOG Receiving, and Middle Basin Capacity, Redundancy and TWAS Optimization

Construction of the remainder of NC Phase 1 (Steps B and C) will provide the Nelson complex with redundancy in anaerobic digestion and opens Nelson to also receiving FOG. Digester 4 becomes an anaerobic digester and Digesters 1 and 2 are converted to post-digestion storage. With the additional digestion capacity, it is possible to construct FOG receiving facilities at the NC WWTF and a more permanent and robust facility for hauled TWAS Unloading.

With FOG receiving at NC, it becomes possible to begin optimizing the beneficial reuse of both FOG and hauled TWAS between the two facilities. Implementation of DLSMB Phase 3 at the same time provides immediate capability to begin that optimization. Phase 3 includes conversion of the existing secondary digester to primary digestion, new post-digestion and gas storage, and TWAS equalization/ Updating of the FOG policy would be required for implementation of that optimization.

Stage III –Nelson Complex Phase 2 (with BNR upgrade)

Improvements to the Nelson Complex WWTF nutrient removal processes are planned to be online around 2028. To accommodate the additional sludge quantity projected to be generated by the BNR process, constructing the 3rd Digester (Digester 5) is required. NC Phase 2 also includes the addition of gas utilization facilities and demolition of Digesters 1 and 2. Updating of the FOG policy is again recommended to address the additional capacity at NC and optimization of gas utilization facilities.

Stage IV – Redundancy Measures at Nelson Complex

Phase 3 at NC is recommended for implementation at such time it is desired to have full redundancy for digestion and FOG acceptance. It includes construction of Digester 6, the final digester in the cloverleaf arrangement. With one digester out of service, there would remain full capacity for FOG receiving up to 30% feed COD, as well as capacity for NC WWTF BNR solids and future hauled TWAS quantities.

Table 9
Improvements Planning Schedule

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Stage I (in millions of $)														
NC Phase 1 – Step A	1.2	2.4	2.5											
DLSMB Phase 1 (FOG Policy & Stability Improvements)	0.2	0.2					0.1	0.1			0.1	0.1		
Stage II														
NC Phase 1 – Step B and C (accomplishes DLSMB Phase 2)					2.4	4.9	4.9							
DLSMB Phase 3					2.0	4.0	4.0							
Stage III														
NC Phase 2 (with BNR upgrade)								2.4	7.2	7.2	7.3			
Stage IV														
NC Phase 3												2.5	4.9	4.9
Cost Per Year	1.4	2.6	2.5	0.0	4.4	8.9	9.0	2.5	7.2	7.2	7.4	2.6	4.9	4.9

Alternative Staging Option – Combination of Nelson Complex Improvements

Prior to Stage II it would be pertinent to re-evaluate the efficacy of combining NC Phase 1 (Steps B and C) with NC Phases 2 and 3 at the time of the Nelson Complex plant replacement. If performed, this approach would change the schedule of the Nelson Complex portion of Stage II, and replace the Implementation Plan Stages III and IV. These changes are reflected in the table below. The combination of the Nelson Complex improvements would provide a lower overall capital cost due to the removal of costs associated with rehabilitating Digesters 1 and 2. However, the option will be higher risk as important NC improvements will not be in place until 2028. If selected, the Alternative Staging would require that the NC perform digestion with only one digester online, and no redundancy for digestion, until the plant replacement is complete. Nelson also cannot provide FOG receiving relief nor FOG receiving backup to Middle Basin until that time. Without FOG receiving at NC, implementation of DLSMB Phase 3 is of less value as its primary benefit is optimizing the beneficial reuse of both FOG and hauled TWAS between the two facilities. However, if conversion of the secondary digester to a primary digester and/or replacement of the existing gas bubble, was desired earlier in the implementation plan

all or part of DLSMB Phase 3 could be accelerated to before Stage II. Further analysis is needed to determine the viability of proceeding with this alternative.

Table 10
Alternative Improvements Planning Schedule

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Stage I														
NC Phase 1 – Step A	1.2	2.4	2.5											
DLSMB Phase 1 (FOG Policy)	0.2	0.2									0.1	0.1		
Stage II														
NC Phase 1B and 1C, 2, and 3								4.5	14	14	14			
Stage III														
DLSMB Phase 3												2.0	4.0	4.0
Cost Per Year	1.4	2.6	2.5	0.0	0.0	0.0	0.0	4.5	14	14	14.1	2.1	4.0	4.0

FIGURES

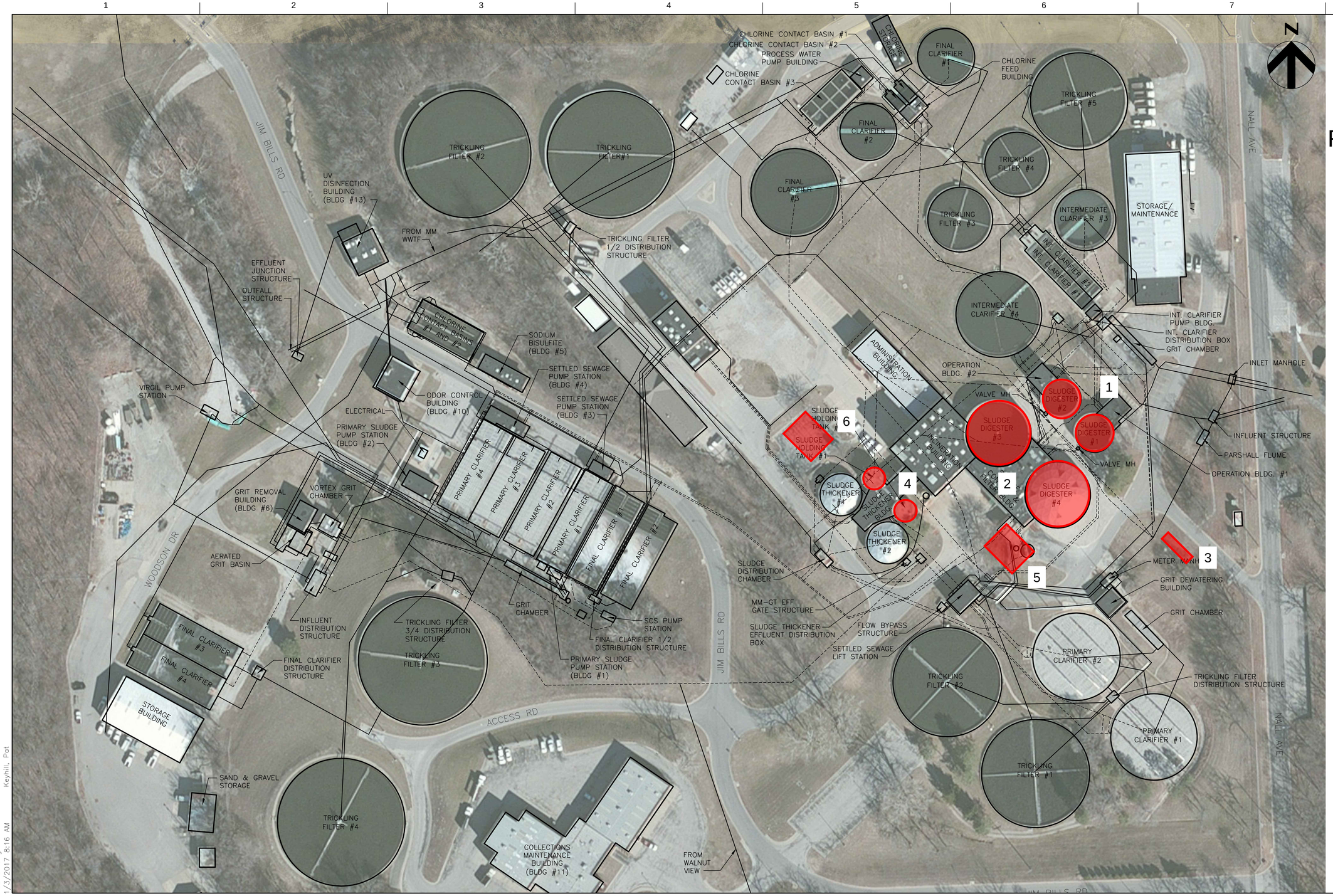

Figure 1: Phase 1 - Resume Digestion Plus FOG Receiving/TWAS Unloading

KEY NOTES

Phase 1

1. Rehab of Digesters 1 and 2
2. Rehab of Digesters 3 and 4
3. Flares
4. Rehab of Sludge Storage Tanks
5. Hauled TWAS and FOG Receiving
6. Hauled TWAS and FOG Receiving (Alternate Location)

Legend

Phase 1

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ISSUE	DATE	DESCRIPTION
A	01-06-17	ISSUED FOR REVIEW

PROJECT MANAGER MICHAEL KALIS

PROJECT NUMBER 00000000XXXXXX

JOHNSON COUNTY WASTEWATER
NELSON COMPLEX WWTF
NELSON AND DLSMB SOLIDS HANDLING STUDY

Mesophilic Digestion

Figure 1: Phase 1 - Resume Digestion Plus FOG Receiving/TWAS Unloading

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SCALE 1" = 60'

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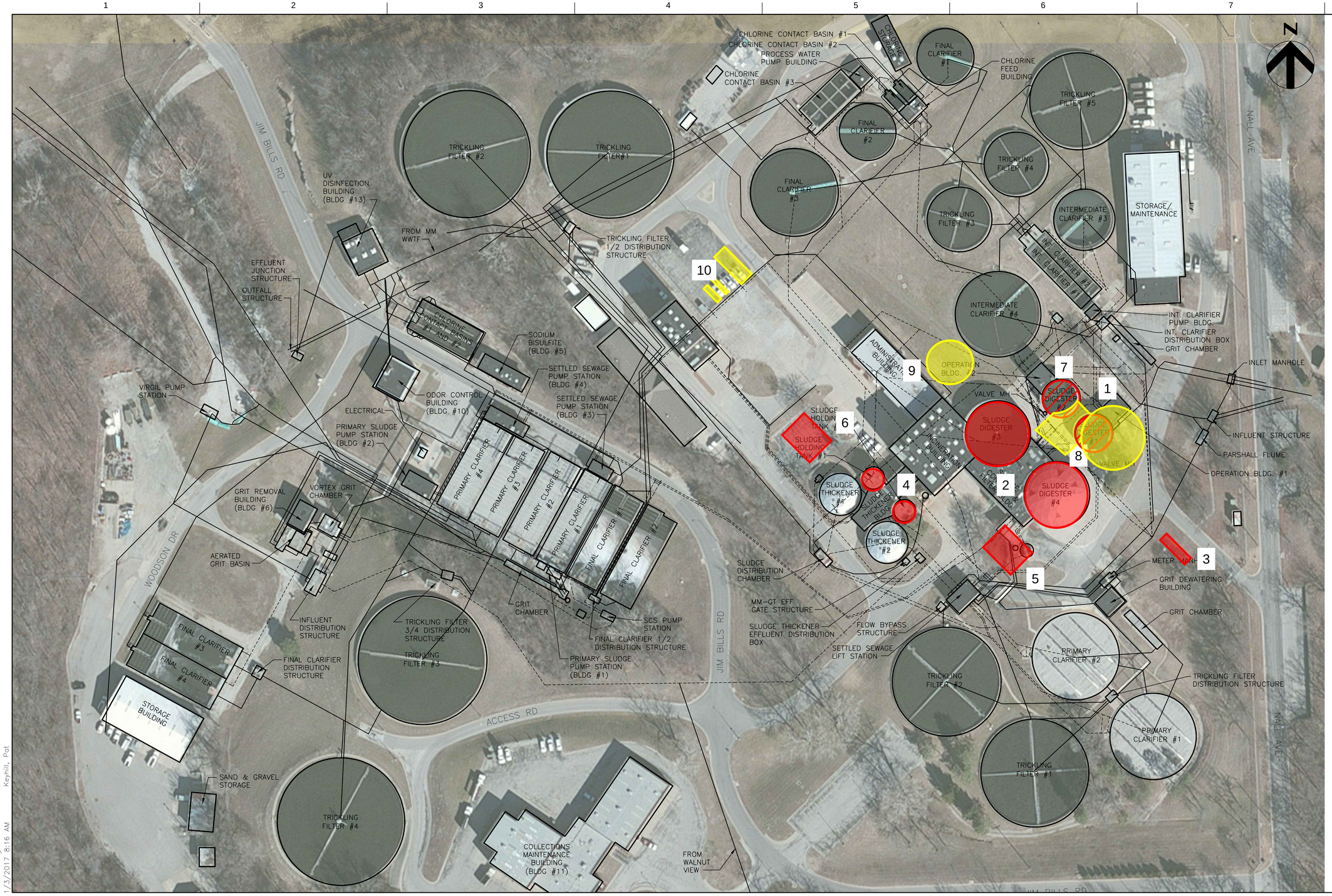

Figure 2: Phase 2 - Enhanced Digestion Plus Biogas Utilization

KEY NOTES

Phase 1

1. Rehab of Digesters 1 and 2
2. Rehab of Digesters 3 and 4
3. Flares
4. Rehab of Sludge Storage Tanks
5. Hauled TWAS and FOG Receiving
6. Hauled TWAS and FOG Receiving (Alternate Location)

Phase 2

7. Demo of Digesters 1 and 2
8. Digester 5 and Control Building Expansion
9. Gas Storage
10. Cogeneration Facilities and Gas Cleaning

Legend

- Phase 1
- Phase 2

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ISSUE	DATE	DESCRIPTION
A	01-06-17	ISSUED FOR REVIEW

PROJECT MANAGER MICHAEL KALIS

PROJECT NUMBER 00000000XXXXXX

JOHNSON COUNTY WASTEWATER
NELSON COMPLEX WWTF
NELSON AND DLSMB SOLIDS HANDLING STUDY

Mesophilic Digestion

Figure 2: Phase 2 - Enhanced Digestion Plus Biogas Utilization

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SCALE 1" = 60'

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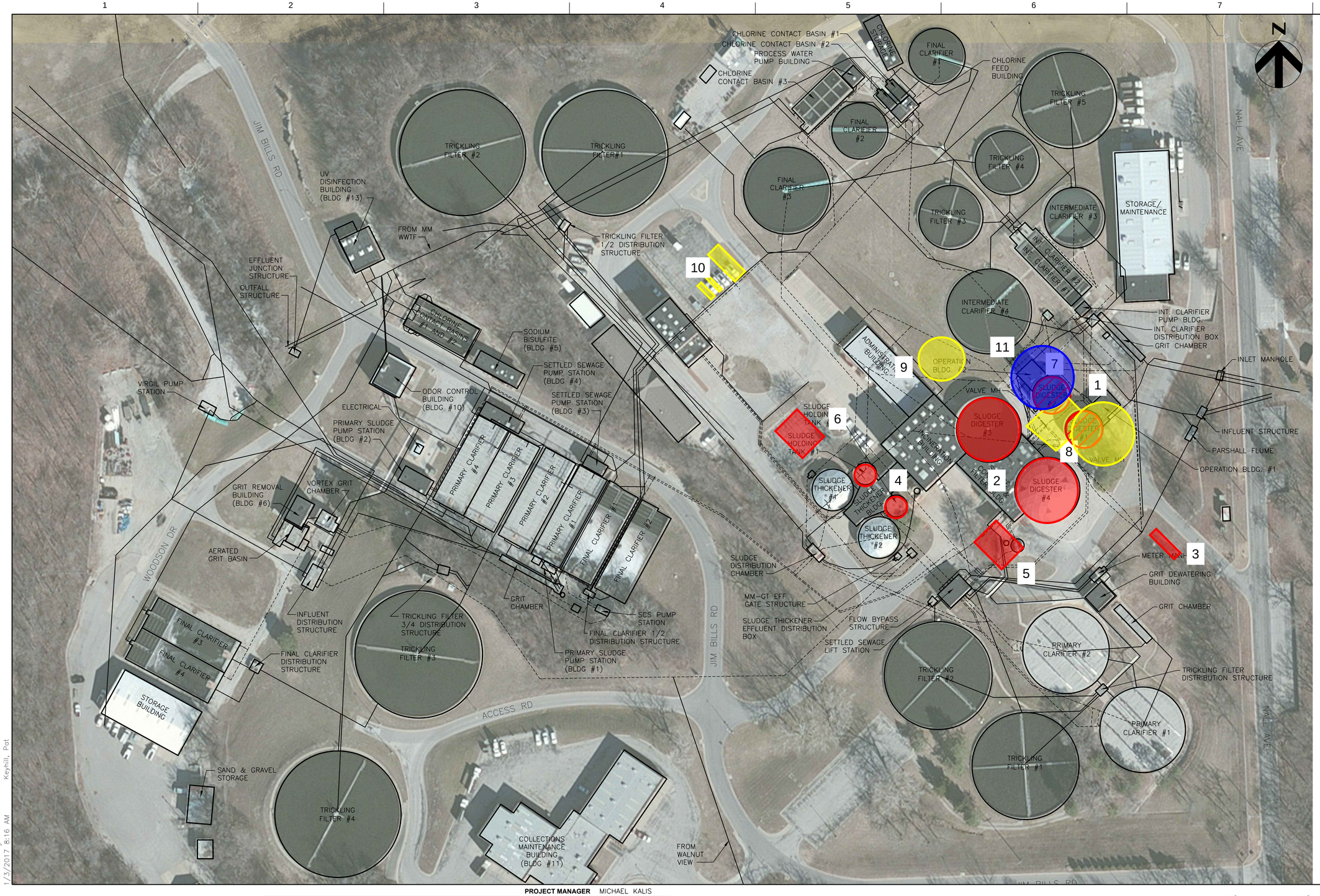

Figure 3: Phase 3 - Redundancy

KEY NOTES

Phase 1

1. Rehab of Digesters 1 and 2
2. Rehab of Digesters 3 and 4
3. Flares
4. Rehab of Sludge Storage Tanks
5. Hauled TWAS and FOG Receiving
6. Hauled TWAS and FOG Receiving (Alternate Location)

Phase 2

7. Demo of Digesters 1 and 2
8. Digester 5 and Control Building Expansion
9. Gas Storage
10. Cogeneration Facilities and Gas Cleaning

Phase 3

11. Digester 6

Legend

- Phase 1
- Phase 2
- Phase 3

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PROJECT MANAGER MICHAEL KALIS

PROJECT NUMBER 00000000XXXXXX

JOHNSON COUNTY KANSAS Wastewater

JOHNSON COUNTY WASTEWATER
NELSON COMPLEX WWTF
NELSON AND DLSMB SOLIDS HANDLING STUDY

Mesophilic Digestion

Figure 3: Phase 3 - Redundancy

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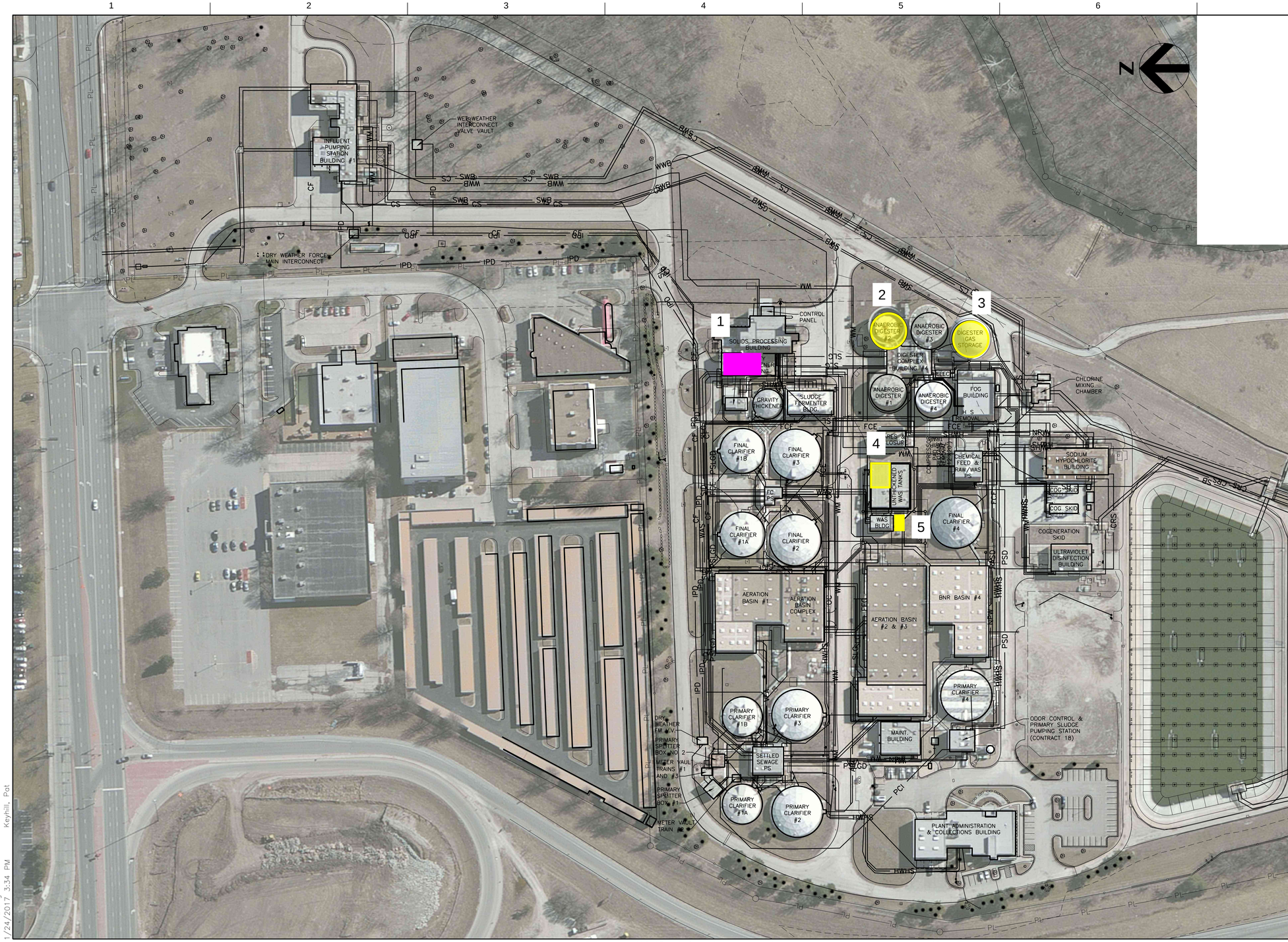
SHEET **10C101**



KEY NOTES

Phase 1

1. Recuperative thickening enhancements for stability improvements.

Phase 3

2. Conversion of Digester 2 from secondary to primary.

3. New digested sludge storage with membrane gas storage

4. Conversion of portion of UWAS tank to TWAS Equalization

5. New pump station to feed blended (Plant-Generated plus Hauled) TWAS to Digesters

Legend

Phase 1

Phase 3

Note: Phase 2 Improvements accomplished at Nelson Complex

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ISSUE	DATE	DESCRIPTION
A	01-06-17	ISSUED FOR REVIEW

PROJECT MANAGER MICHAEL KALIS

PROJECT NUMBER 00000000XXXXXX

JOHNSON COUNTY WASTEWATER
NELSON COMPLEX WWTF
NELSON AND DLSMB SOLIDS HANDLING STUDY

Figure 4: D.L.S. Middle Basin WWTF Improvements and Phasing

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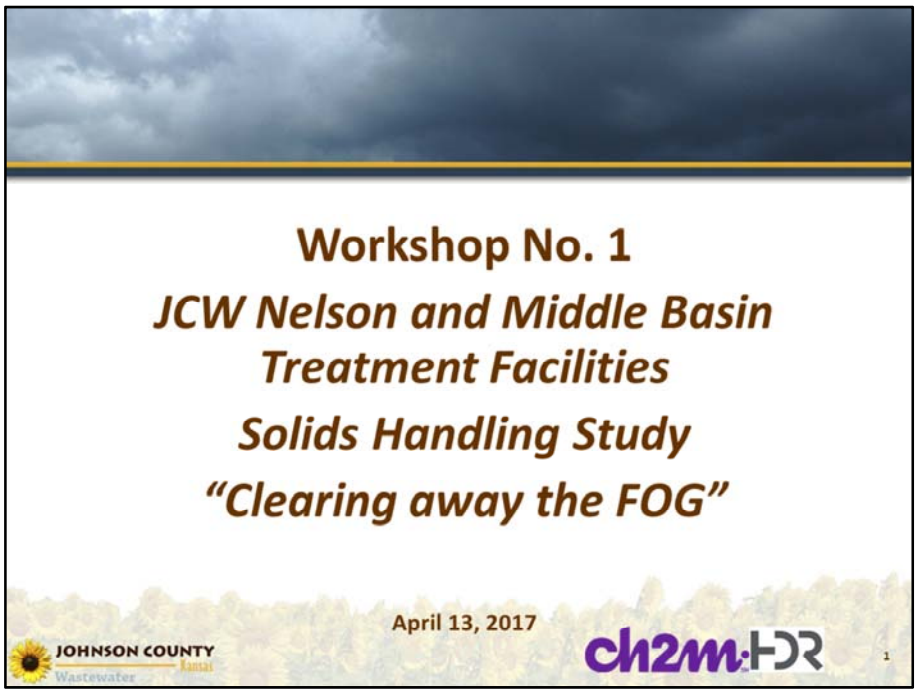
APPENDIX A

Minutes of

Workshop No. 1 - Screening of Alternatives

and

Workshop No. 2 - Analysis of Retained Alternatives



Meeting Minutes are provided here in NOTES

Agenda

- Introductions
- Meeting Goals
- Review Results of Analyses under Tasks 1, 2 and 3
- Review of FOG Analyses with B & V (about 2 pm)
- Attain Consensus on Solids Loadings and Alternatives to retain for Detailed Analysis
- Closing/Next Steps

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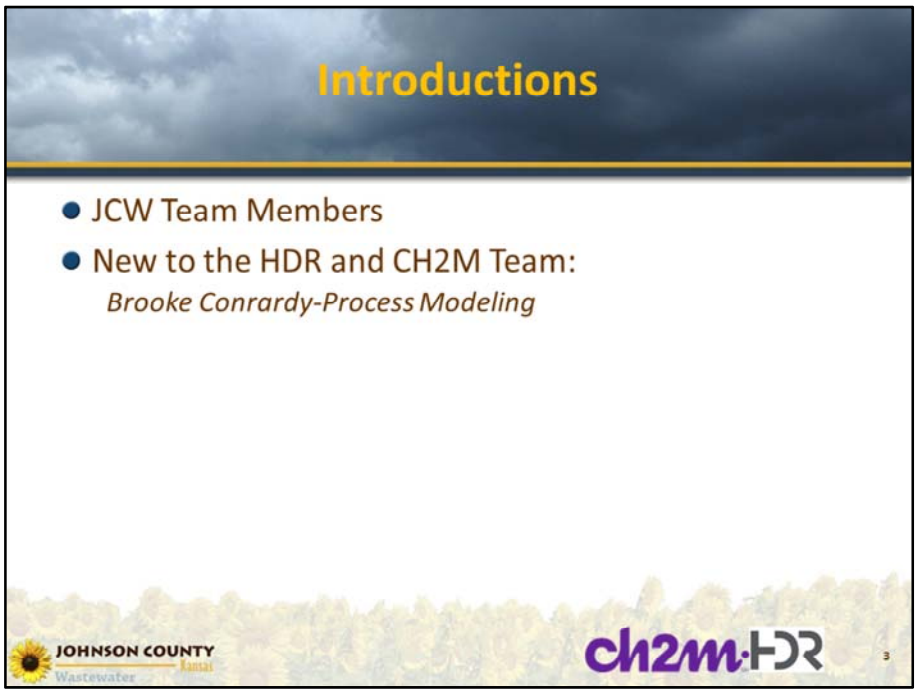
2



See attendance list attached (Attachment 1).

Meeting Goals

- Review Results of Analyses under Tasks 1, 2 and 3:
  - *Task 1 – Data Collection and Projected Biosolids and FOG Quantity and Quality Analysis-Nelson, TWAS and FOG*
  - *Task 2- Nelson Complex WWTF Process Capacity and Performance Assessment*
  - *Task 3 – Nelson Complex Identification and Definition of Alternatives-High Level Screening*
- Reach Consensus on:
  - ***Solids projections for Nelson, TWAS and FOG***
  - ***Selection of alternatives to retain detailed analysis for anaerobic digestion, biogas utilization, and biosolids use***

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4

Current and Projected Biosolids and FOG Quantity and Quality Analysis-Nelson, TWAS and FOG

- Projections
  - *FOG*
  - *BRM1 WWTF TWAS*
  - *NCAC WWTF TWAS*
  - *Tomahawk WWTF TWAS*
  - *Nelson WWTF*
  - *"The Bottom Line"*

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5

FOG

- FOG
  - *Challenging to get accurate data on both quantity and quality*
  - *COD, TS, VSS data limited and old (2007, 2010-2012)*
  - *Three primary components:*
    - Johnson County Restaurant FOG
    - Johnson County Industrial FOG
    - Metro Area Restaurant FOG

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6

FOG, cont.

- Johnson County Restaurant FOG Estimates
  - *Hauling records from JCH&E for JCW jurisdiction restaurant FOG*
  - *JCW Restaurant Lablite Data:*
    - TS-4%
    - VS-89%
    - COD-87,000 mg/l
    - pH-4.4
  - *Johnson County Restaurant FOG Projected based on ratio of Interceptors in JCW plus Olathe vs JCW only (1,016 in JCW, 56 in Olathe)*

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7

Johnson County Grease Interceptor/Restaurant FOG Production

Parameter	JCW 2016	Johnson Co. 2016 [1]
Grease Interceptors	1,016	1,072
Annual Total (gal/yr)	4,600,000	4,850,000
Mass TS ppd	4,200	4,400
Population		580,000
Lbs TS/person/year		2.8

(1) Assumes 2016 Johnson Co. population of 580,000 (value actually represents July 2015 census population estimate).
(2) Calendar average, not working days
(3) Not 2016 data. Data used comes from 2007 to 2012 time period

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8

Advised that 2.8 lbs TS/person/year is low (as compared to NREL report "Urban Waste Grease Resource Assessment" that found average restaurant FOG production of 30 cities studied was 13.4 lbs/person/year.)

Industrial FOG

- JCW Industrial FOG
  - *Volume based on estimate from JCW staff (6,000 gpd)*
  - *Characteristics highly variable (4% to 38% TS)*
  - *Includes data on COD and VSS from some industries no longer hauled to DLSMB, i.e., Danisco*

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9

Historical Johnson County Industrial FOG quality data

	TS%	VS%	COD (mg/L)	pH
DARLING INTERNATIONAL	20	91	456,000	4.3
CFS WEST HOLDINGS	24	94	301,000	4.5
KERRY (before dewater)	10	65	199,000	5.1
UNILEVER	11	80	174,000	5.1
AVERAGE	16	83	300,000	4.8

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10

In comparison to the above, B&V adopted COD values of 358,000 mg/L for Industrial FOG.

Johnson County Total Grease Interceptor/Restaurant FOG plus Industrial FOG

Parameter	Johnson County Grease Interceptor/ Restaurant 2016	Johnson County Industrial 2016	Johnson Co. Total 2016 FOG production
Annual Total (gal/yr)	4,850,000	2,190,000	7,040,000
AA gpd [2]	13,300	6,000	19,300
Concentration [3]			(calculated, flow-weighted, blend)
TS	4	16	7.7%
VS	89	83	
COD	87,000	300,000	
pH	4.4	4.8	
Mass			
TS ppd	4,400	8,000	12,400
Lbs/person/year [1]	2.8	5.0	7.8

(1) Assumes 2016 Johnson Co. population of 580,000 (value actually represents July 2015 census population estimate).
(2) Calendar average, not working days
(3) Not 2016 data. Data used comes from 2007 to 2012 time period

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11

In comparison to the above, B&V adopted COD values of 59,000 mg/L for restaurant grease and 358,000 mg/L for Industrial FOG.

Metro Area Restaurant FOG

- Metro Wide FOG
  - *Assumed all FOG delivered to DLSMB from 10/1/15 to 5/31/16 represented total Metro FOG production*
  - *Comparing Johnson County FOG Estimates to Metro Found:*
    - Johnson County represented 44% of Metro restaurant FOG
    - Johnson County represented 64% of Metro total FOG (with Industrial FOG)
    - Johnson County represented 29% of Metro population
    - Possible reasons for this, i.e., JCW likely more strict on hauling frequency, JC may have higher proportion of restaurants, etc.
    - This, and low per capita FOG production lead to alternate analysis
  - *Overall, Restaurant FOG difficult to predict future trends*

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12

Metro Area Restaurant FOG, cont.

- Metro Area FOG, cont.
  - *Alternate Estimate of Metro FOG:*
    - Use 2.8 lbs/capita/year restaurant FOG based on Johnson County Planning 2015 population estimate (below NREL published range)
    - Use TS concentration range of 4% (historical JCW data available) to 7.5% (midpoint of reference text range of 5-10%)
    - Result is range of volume of FOG
  - *2030 projection based on ratio of 2015 to 2030 Johnson County Planning population estimates*
    - Johnson County 26% Increase: 580,000 to 730,000
    - Metro 16% Increase: 1,980,000 to 2,300,000

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13

Projected 2030 Quantity from all FOG sources

Parameter	Johnson Co. 2030 Grease Interceptors	Johnson Co. Industrial FOG	Total Johnson Co. only FOG Sources	Metro Area 2030 Grease Interceptors	Metro Area 2030 plus Johnson Co. Industrial FOG
Population Served	730,000	NA	730,000	2,300,000	2,300,000
Lbs TS/person/year	2.8	NA		2.8	
TS ppd	5,600	10,000	15,600	17,600	27,600
Concentration TS %	4 - 7.5	20		4 - 7.5	
AA gpd [1]	16,800 - 9,000	6,000	22,800 – 15,000	52,900 – 28,200	58,900 – 34,200

(1) Calendar average, not working days

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14

All parties agreed that the approach for projecting metro area FOG quantities is reasonable.

Projections were also reviewed with Black & Veatch. In comparison to the above, B&V adopted COD values of 59,000 mg/L for restaurant grease and 358,000 mg/L for Industrial FOG. B&V has submitted to JCW its assessment of DLSMB capabilities to accept FOG, and JCW will forward to CH2M. Document discusses conclusion that DLSMB can accept 32,000 gal/day of FOG, but it's recommended to cap at 25,000 gpd for now to manage receipt of deliveries. Of the 32,000 gal/day of FOG, it is recommended that DLSMB only accept 6,000 gal/day of industrial FOG.

B&V has provided mechanical and process improvement suggestions for DLSMB.

Blue River WWTF TWAS

- BRM1 WWTF TWAS
  - *Based primarily on Lablite Data*
  - *Metered Flow available*
  - *Number of Tanks Hauled Available*
  - *TS Data in Lablite-Average 4.3%*

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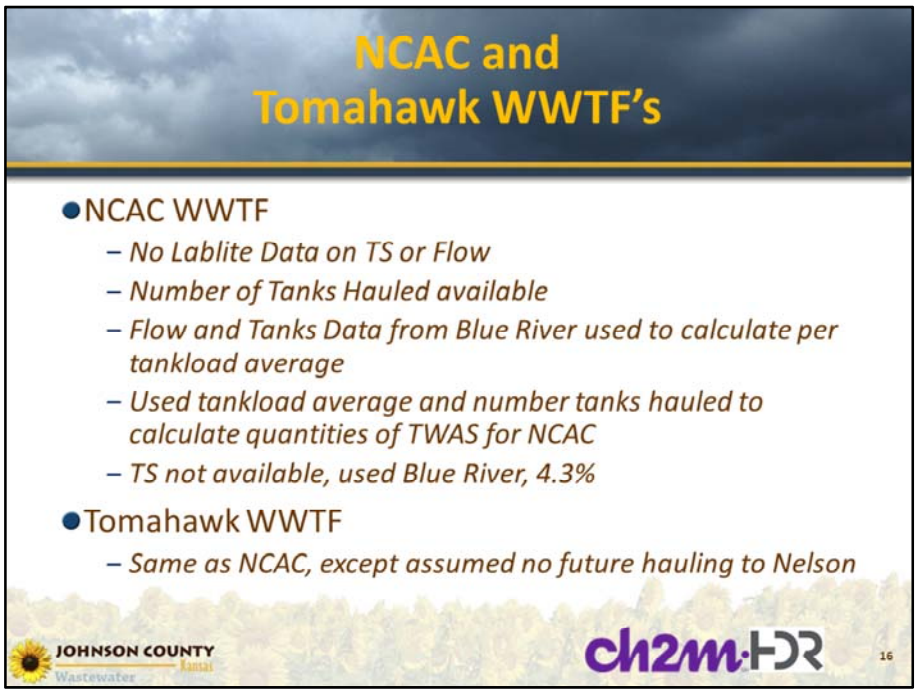
15



JCW noted that NCAC TWAS may be somewhat thinner than BRM1 TWAS (tested once at 3.5%).

Summary of Trucked TWAS by Source (2010-2016)

Year	From BRM (MG/yr)	From NCAC (MG/yr)	From Tomahawk (MG/yr)	Total TWAS (MG/yr)	BRM lbs TWAS produced per MG treated (1)	NCAC lbs TWAS produced per MG treated (2)
2010	6.93	2.35	-	9.28	1,200	4,200
2011	9.01	3.10	-	12.11	1,800	5,900
2012	7.12	2.79	-	9.91	1,500	5,500
2013	6.71	2.67	-	9.38	1,200	4,600
2014	6.55	2.71	-	9.26	1,300	4,600
2015	6.82	3.79	1.66	12.27	1,200	4,700
2016	5.98	3.03	2.88	11.89	1,200	4,300

(1) TS data on BRM TWAS is only available for years 2015 and 2016. Average of 4.3% is assumed.
(2) TS data is not available for NCAC. It is assumed to match BRM at 4.3%.

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17

Yellow highlighting reflects values selected for use in projections on Slide 18. (1,200 lbs/MG for BRM and 4,500 lbs/MG for NCAC)

Projected Future TWAS Quantities

Parameter	BRM	NCAC	Total TWAS
lbs TWAS /MG Treated	1,200 (1)	4,500 (1)	
Rated Capacity (MGD)	10.5 (2)	1.65 (3)	
Design AA TWAS (ppd)	12,600	7,400	20,000 ppd (AA)

(1) Average of most recent 2 years (2015 and 2016 data), rounded to the nearest hundred, was selected for use in projections.
(2) Based on 3 trains, 3.5 mgd of capacity each. It is assumed that when capacity of existing facility is exceeded, solids handling facilities will be constructed with the expansion and TWAS hauling from BRM will cease.
(3) Based on rated capacity for Alternative 2 Improvements as described in Nutrient Removal Study, New Century Air Center WWTP (Black & Veatch, October 2013).

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18

It was confirmed that NCAC would be expected to have approximately 4X higher sludge yield/MG treated than BRM. Use of above values for projecting future TWAS was approved.

Nelson Complex WWTF

- Nelson Complex WWTF
  - *Based primarily on Lablite Data*
  - *Data Averages show for centrifuge feed:*
    - 4.5% TS without TWAS, 3.5% TS with TWAS
    - 75% VS
    - MM/AA averaged 1.3 for both Nelson and TWAS
  - *Used Current Capacity (15 MGD) and assumed BNR (replacement alternative) for projecting future quantities*
  - *Results in current Nelson solids production estimate of 15,000 ppd*

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19

Nelson WWTF Centrifuge Dewatering Data (2010-2016)

Year	TWAS Hauled to Nelson (ppd) (1)	Total Centrifuge Feed (MG/yr)	AA % TS (%)	Calculated AA centrifuge feed (ppd) (1)	AA VS %	MM/AA Peaking Factor	Landfilled AA (ppd)
2010	18,100	26.02	3.69	22,000	74.6	1.24	18,100
2011	16,500	22.37	3.43	17,500	74.6	1.20	16,500
2012	13,600	21.14	3.44	16,600	76.0	1.43	13,600
2013	12,200	15.29	4.30	15,000	74.3	1.34	12,200
2014	12,600	14.72	4.63	15,600	74.7	1.40	12,600
2015	13,400	16.36	4.09	15,300	74.2	1.29	13,400
2016	15,200	22.52	3.75	19,300	74.0	1.31	15,200
2016 (May-Oct)	19,500	16.15	3.51	26,300	71.5	1.18	19,500

(1) Calculated based on average over all days in time period

- Orange rows represent years when peak TWAS quantities were hauled to Nelson WWTP.
- Green represents the year when the least amount of TWAS was being hauled to Nelson WWTP.

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20

Nelson Complex WWTF Data Observations

- Nelson solids production volume impacted by TWAS
- Nelson solids VS not impacted by TWAS
- There was no year when TWAS was not hauled to Nelson, but 2014 had the least TWAS hauled (gals)
- No firm correlation between solids ppd TWAS hauled and increase of ppd at Nelson, but best correlation if assumed 70% TWAS solids pass through to centrifuge
- Mass balance indicates 83% solids capture at Nelson dewatering -will use more typical 90-95% for projections
- 4.5% TS to centrifuge without TWAS, 3.5% TS with TWAS

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21

"The Bottom Line"

- Total 2030 Solids Projections
  - *Nelson WWTF*
  - *BRM1 WWTF TWAS*
  - *NCAC WWTF TWAS*
  - *Metro Area FOG*

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22

The "Bottom Line"

2030	Nelson Only – Current WWTP	Nelson (current) plus all TWAS into Collection System	Nelson (current) plus all TWAS to solids blend tank	Nelson (current) plus all FOG	Nelson (current) plus all TWAS and all FOG	Nelson Only – BNR ("C" series from Nutrient Study)	Nelson (BNR) plus all TWAS and all FOG
AA							
Nelson	15,000 ppd 4.5% TS 75% VS	15,000 ppd 3.5% TS 75% VS	15,000 ppd 4.5% TS 75% VS	15,000 ppd 4.5% TS 75% VS	15,000 ppd 4.5% TS 75% VS	34,000 ppd 5.4% TS 60% VS	34,000 ppd 5.4% TS 60% VS
TWAS (1)		14,000 ppd 3.5% TS 75% VS	20,000 ppd 4.3% TS 75% VS		20,000 ppd 4.3% TS 75% VS		20,000 ppd 4.3% TS 75% VS
FOG (2)				27,600 ppd 7.0% TS 87% VS	27,600 ppd 7.0% TS 87% VS		27,600 ppd 7.0% TS 87% VS
Total	15,000 ppd 4.5% TS	29,000 ppd 3.5% TS	35,000 ppd 4.4% TS	42,600 ppd 5.9% TS	62,600 ppd 5.2% TS	34,000 ppd 5.4% TS	81,600 ppd 5.5% TS
MM							
Nelson	19,500 ppd 4.5% TS 75% VS	19,500 ppd 3.5% TS 75% VS	19,500 ppd 4.5% TS 75% VS	19,500 ppd 4.5% TS 75% VS	19,500 ppd 4.5% TS 75% VS	44,200 ppd 5.4% TS 60% VS	44,200 ppd 5.4% TS 60% VS
TWAS (1)		18,200 ppd 3.5% TS 75% VS	26,000 ppd 4.3% TS 75% VS		26,000 ppd 4.3% TS 75% VS		26,000 ppd 4.3% TS 75% VS
FOG (2, 3)				33,100 ppd 7.0% TS 87% VS	33,100 ppd 7.0% TS 87% VS		33,100 ppd 7.0% TS 87% VS
Total	19,500 ppd 4.5% TS	37,700 ppd 3.5% TS	45,500 ppd 4.4% TS	52,600 ppd 5.8% TS	78,600 ppd 5.2% TS	44,200 ppd 5.4% TS	103,300 ppd 5.4% TS

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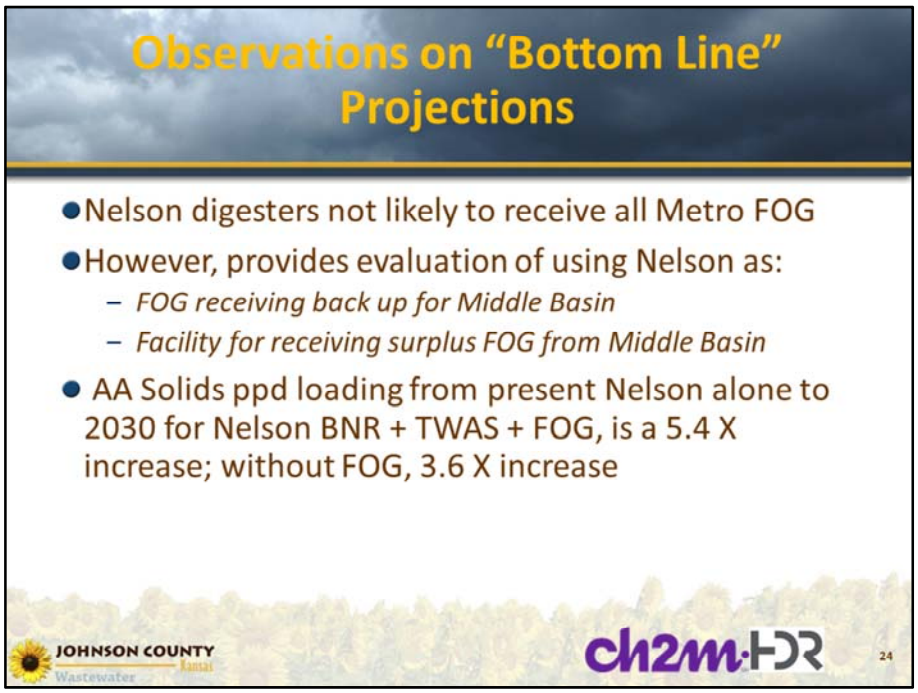
23

The "C" series alternatives from the Nutrient study indicate that total replacement of the trickling filters with BNR activated sludge will result in a blended solids stream to digestion that is: a) thicker than current stream (due to modeled centrifuge to thicken WAS stream), b) lower in % VS (lower in energy), and c) higher in nutrient content. Handout (Attachment 2) was provided that included additional columns to limit FOG contribution to remain within acceptable limit of FOG COD/Total COD ratio in digester feed stream. Attachment 2 has been revised to include Scenario G3 to reflect Nelson BNR plus all TWAS.



It was discussed that the amount that needs to be hauled to landfill would increase approximately 2.2X with Nelson BNR, all TWAS and Max FOG, as compared to current condition of Nelson AA solids and all TWAS into collection system.

Non-monetary screening criteria

Criterion	Description
Flexibility/Performance Risk	How well is the alternative able to successfully deal with fluctuations of flow and load; e.g., number of "tools" available to respond to changing conditions? Is it resistant to upset conditions? How extensive are the ramifications if all or part of the process fails? Does the alternative reduce chemical handling risks? Has pathogen or fecal coliform reactivation or regrowth been associated with the alternative/process?
Adaptability/Phasing	How easily can the upgrade be phased to meet JCW's needs over time in a cost-effective manner? How easily can the alternative/process be upgraded in the future to reliably produce a Class A Biosolids?
Proven Experience/ Domestic Support	How well proven is the technology in the application required for this project? Is the equipment and technology supported in the U.S.?
Staffing/Multiple Processes	Does the alternative require additional staffing? How well does the alternative match with existing operational staff in terms of capabilities, procedures, required certifications, and experience? Does the alternative incorporate additional unit processes or additional chemical systems that increase risk?

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25

Revisions made during workshop are included in slide table above.
Although achieving Class A biosolids is not a priority, JCW recognizes the cost savings potential and lower reporting requirements as a valuable benefit.

Non-monetary screening criteria, cont.

Criterion	Description
Sidestream Impacts	Does the alternative produce a sidestream that requires additional treatment prior to the liquids treatment train? How extensive or complex are the sidestream treatment requirements?
Land/Building Requirements	How well does the alternative fit on the existing site or within existing buildings? Does the alternative interfere with space that may be required for other future improvements?
Social Impacts	How well does the alternative prevent off-site impacts for traffic, noise, odors, visual, etc. How well does the alternative minimize sludge handling efforts? Higher degree of stabilization is an environmental benefit.

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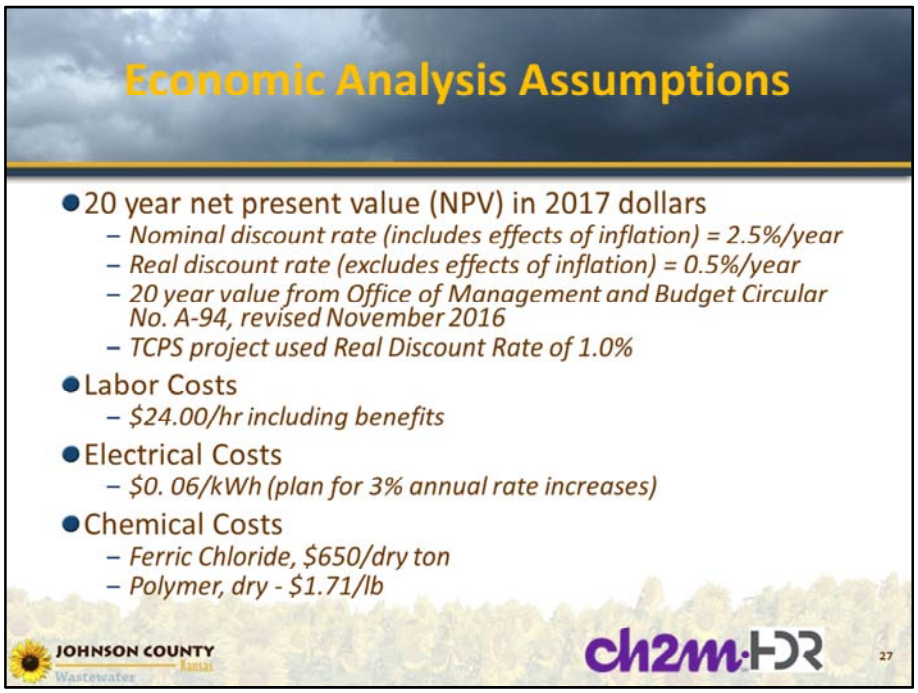
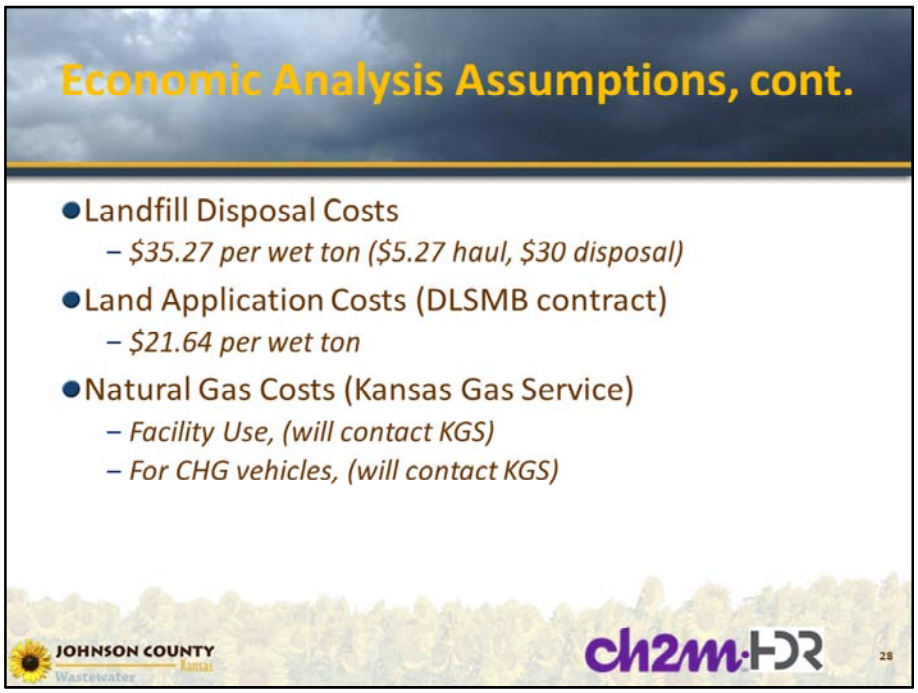
26

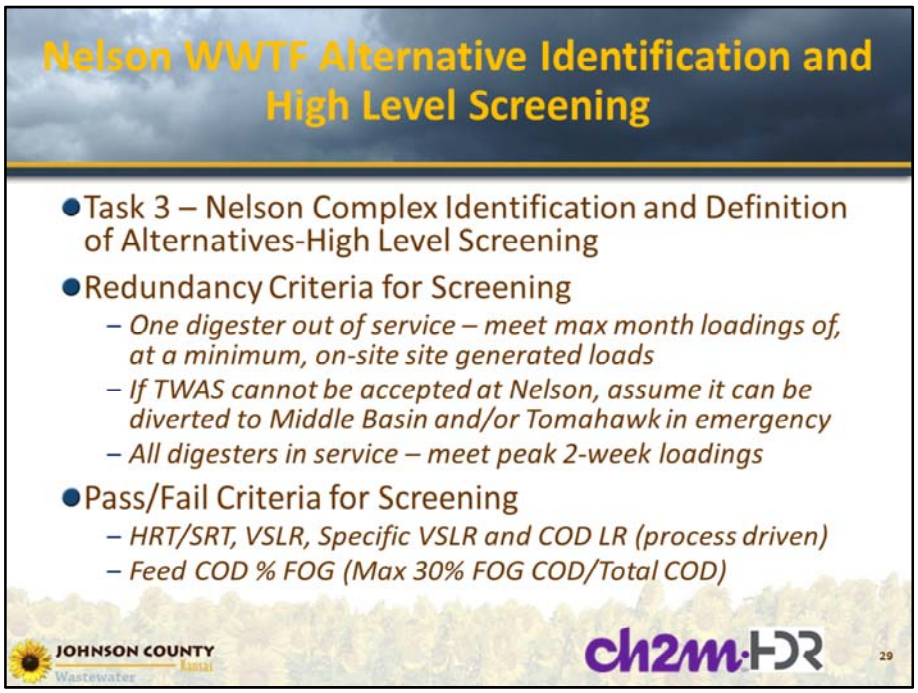
Revisions made during workshop are included in slide table above.



NPV assumptions for nominal and real discount rate will be reviewed and provided by JCW. Terry will get labor, electrical and chemical costs verified or updated.



Landfill and land application data was provided in response to data request. However, staff was concerned that landfill value may not be current. Terry will advise if landfill values need updated. CH2M will contact Kansas Gas Service.



Redundancy criteria will be revised to require both on-site generated, <u>and hauled TWAS</u>, max month loads to be handled with one digester out of service.

Max Month – Limitations on Max Feed FOG %

TS Received (ppd)	Nelson Current Sludge Only	Nelson Current Sludge Plus All TWAS	Nelson w/BNR Facility Sludge Only	Nelson w/BNR Facility Plus All TWAS
Nelson	19,500	19,500	44200	44,200
TWAS	0	26,000	0	26,000
FOG	6,000 (18% of metro area)	12,000 (36% of metro area)	7,600 (23% of metro area)	13,600 (41% of metro area)

Limitation is to not exceed maximum of 30% FOG feed COD/Total feed COD

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30

Nelson Complex WWTF Enhancement Alternatives

- Process enhancement alternatives for each facility based on preferred components identified in Task 2 for:
  - *Anaerobic digestion*
  - *Biogas utilization*
  - *Biosolids use*
  - *BRM1 and NCAC TWAS receiving*
  - *FOG waste receiving and handling*

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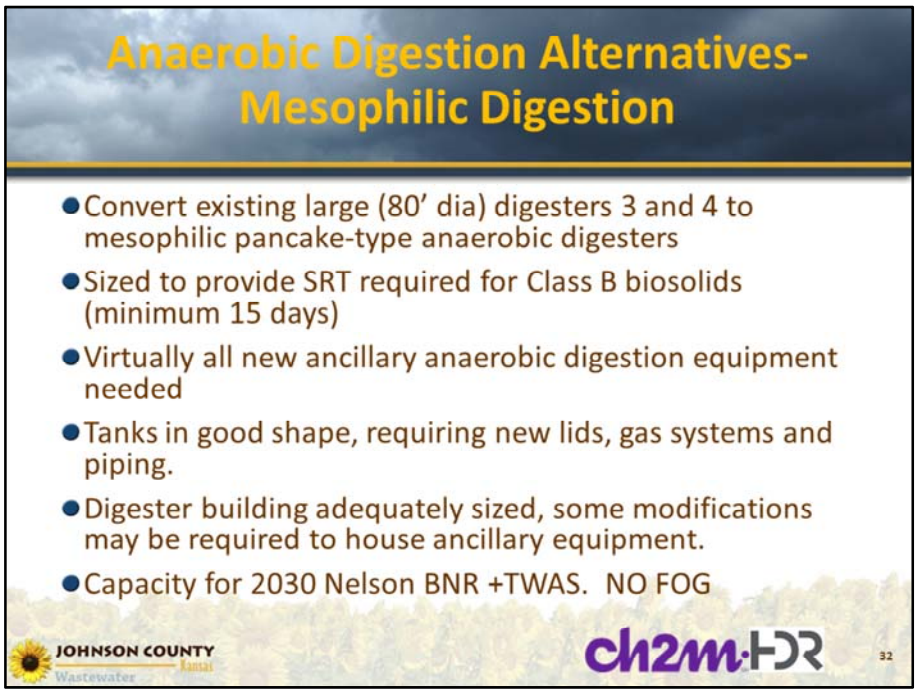
31



If two existing digesters do not provide capacity for digestion loads, base alternative will assume additional 3rd mesophilic digester could be constructed in future. Reference attachment 3 for one-page summaries of each alternative.

Max Month – One Mesophilic Digester
On-site Generated Loads Only

TS Received (ppd)		Nelson Current Sludge Only	Nelson w/BNR Only
Nelson		19500	44200
TWAS		0	0
FOG		0	0
Pass/Fail Criteria		**Scenario A**	**Scenario F**
HRT/SRT	<15 Days	27.9	12.5
VSLR	>0.15	0.08	0.14
SVSLR	>0.16	0.08	0.16
S COD LR	>0.25	0.15	0.25
COD FOG/Total	>0.30	0	0
VS Reduction		55%	50%
TS Leaving	>3.2%	2.64%	3.2%

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33

Will be revised to reflect accepting TWAS with one digester out of service. (reference attachment 4 for updated table)

Peak 2 Week – Two Mesophilic Digesters On-Site plus Hauled Streams

TS Received (ppd)		Current, TWAS and max FOG	BNR, TWAS and max FOG
Nelson		21,000	47,600
TWAS		28,000	28,000
FOG		13,000	15,000
Pass/Fail Criteria		**Scenario E2**	**Scenario G2**
HRT/SRT	<15 Days	17.9	12.9 (14.7 w/zero FOG)
VSLR	>0.15	0.12	0.16
SVSLR	>0.16	0.13	0.18
S COD LR	>0.25	0.23	0.28
COD FOG/Total	>0.30	0.30	0.30
VS Reduction		58%	56%
TS Leaving	>3.2%	2.5%	3.0% (3.2% w/zero FOG)

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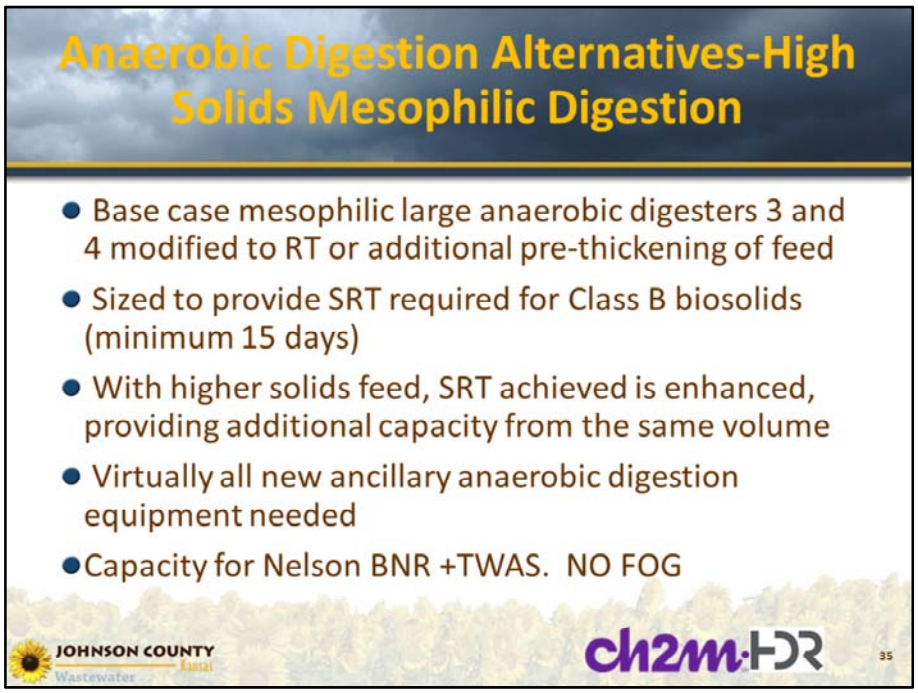
34



Reference attachment 3 for one-page summaries of each alternative.

Max Month – One Mesophilic Digester
Higher Solids NOT FEASIBLE

TS Received (ppd)		Nelson Current Sludge Only	Nelson w/BNR Only
Nelson		19500	44200
TWAS		0	0
FOG		0	0
Pass/Fail Criteria		**Scenario A**	**Scenario F**
HRT/SRT	<15 Days	27.9	12.5
VSLR	>0.15	0.08	0.14
SVSLR	>0.16	0.08	0.16
S COD LR	>0.25	0.15	0.25
COD FOG/Total	>0.30	0	0
VS Reduction		55%	50%
TS Leaving	>3.2%	2.6%	3.2%

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36

Will be revised to reflect accepting TWAS with one digester out of service. (reference attachment 4 for updated table)

Peak 2 Week – Two Mesophilic Digesters
Higher Solids NOT FEASIBLE

TS Received (ppd)		Current, TWAS and max FOG	BNR, TWAS and max FOG
Nelson		21,000	47,600
TWAS		28,000	28,000
FOG		13,000	15,000
Pass/Fail Criteria		**Scenario E2**	**Scenario G2**
HRT/SRT	<15 Days	17.9	12.9 (14.7 w/zero FOG)
VSLR	>0.15	0.12	0.16
SVSLR	>0.16	0.13	0.18
S COD LR	>0.25	0.23	0.28
COD FOG/Total	>0.30	0.30	0.30
VS Reduction		58%	56%
TS Leaving	>3.2%	2.5%	3.0% (**3.2% w/zero FOG**)

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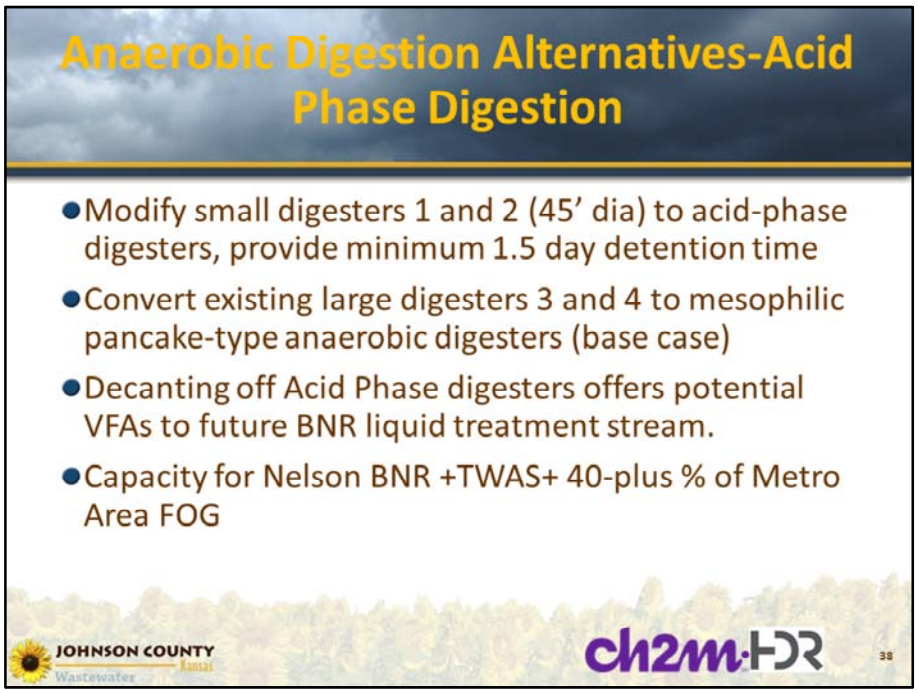
37



Acid phase should be variable volume for process control. Desired pH is maintained by controlling time in acid phase. Reference attachment 3 for one-page summaries of each alternative.

Max Month – One Acid/Mesophilic Train
On-site Generated Loads Only

TS Received (ppd)		Nelson Current Sludge Only	Nelson w/BNR Only
Nelson		19500	44200
TWAS		0	0
FOG		0	0
Pass/Fail Criteria		**Scenario A**	**Scenario F**
HRT/SRT	<1.5/12 Days	4.6/27.9	2.0/12.5
VSLR	>0.15	0.06	0.12
SVSLR	>0.16	0.08	0.15
S COD LR	>0.25	0.14	0.24
COD FOG/Total	>0.30	0	0
VS Reduction		60%	55%
TS Leaving	>3.2%	2.5%	3.1%

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Will be revised to reflect accepting TWAS with one digester out of service. (reference attachment 4 for updated table)

Peak 2 Week – Two Acid/Mesophilic Trains Handles All On-Site and TWAS (near on max FOG)

TS Received (ppd)		Current, TWAS and max FOG	BNR, TWAS and max FOG
Nelson		21,000	47,600
TWAS		28,000	28,000
FOG		13,000	15,000
Pass Fail Criteria		**Scenario E2**	**Scenario G2**
HRT/SRT	<1.5/12 Days	2.9/17.9	2.1/12.9
VSLR	>0.15	0.11	0.14
SVSLR	>0.16	0.12	0.17
S COD LR	>0.25	0.22	0.26
COD FOG/Total	>0.30	0.30	0.30
VS Reduction		62%	60%
TS Leaving	>3.2%	2.4%	2.8%

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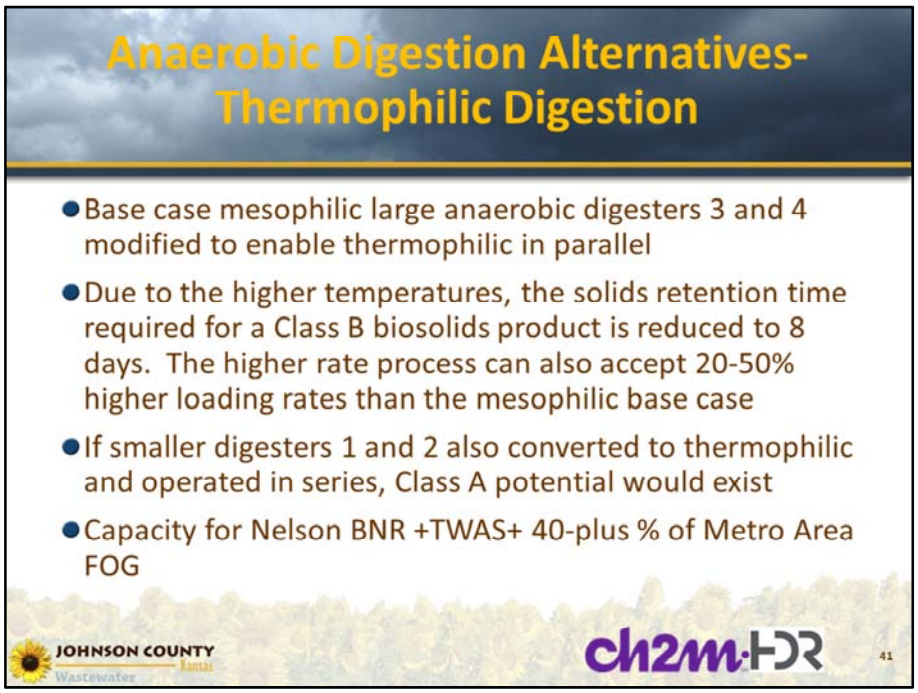
40



Critical process control parameter is maintaining consistent temperature. May produce approximately 1% better cake if thermophilic temperature held to dewatering, but increased odors at dewatering would be experienced. Reference attachment 3 for one-page summaries of each alternative.

Max Month – One Thermophilic Digester On-site Generated Loads Only

TS Received (ppd)		Nelson Current Sludge Only	Nelson w/BNR Only
Nelson		19500	44200
TWAS		0	0
FOG		0	0
Pass/Fail Criteria		**Scenario A**	**Scenario F**
HRT/SRT	<8 Days	27.9	14.5
VSLR	>0.3	0.08	0.14
SVSLR	>0.32	0.10	0.17
S COD LR	>0.5	0.19	0.23
COD FOG/Total	>0.30	0	0
VS Reduction		65%	60%
TS Leaving	>3.4%	2.3%	3.4%

JOHNSON COUNTY Kansas Wastewater

ch2m HDR

42

Will be revised to reflect accepting TWAS with one digester out of service. (reference attachment 4 for updated table)

Peak 1 Week – Two Thermophilic Digesters Handles All On-Site, TWAS, and max FOG

TS Received (ppd)		Current, TWAS and max FOG	BNR, TWAS and max FOG
Nelson		22,500	51,000
TWAS		30,000	30,000
FOG		13,000	15,000
Pass/Fail Criteria		**Scenario E2**	**Scenario G2**
HRT/SRT	<8 Days	16.9	12.6
VSLR	>0.3	0.13	0.17
SVSLR	>0.32	0.17	0.22
S COD LR	>0.5	0.29	0.33
COD FOG/Total	>0.30	0.30	0.30
VS Reduction		65%	64%
TS Leaving	>3.4%	2.3%	2.8%

JOHNSON COUNTY Kansas Wastewater

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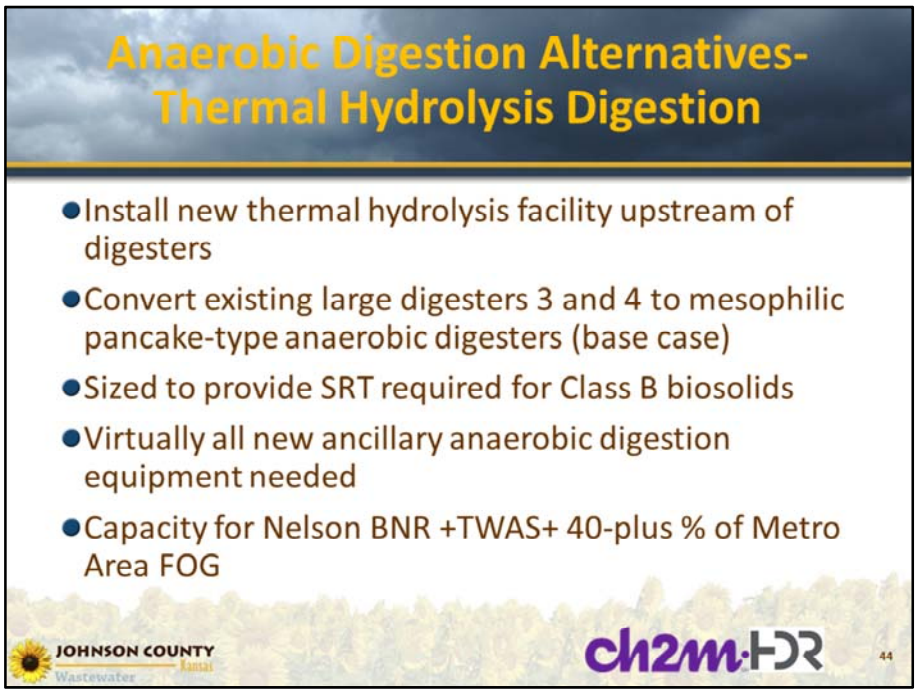
43



THP will require 2-3 certified high pressure steam operators (must cover all shifts). The process is more complex than what JCW currently operates. No regrowth and dewaterability can be much better (up to 10% improvement). Currently exists in USA, or design underway, in DC Water, San Francisco, Trinity River (TX), and in Tennessee. More heavily utilized in Europe. Reference attachment 3 for one-page summaries of each alternative.

Max Month – One Mesophilic Digester w/THP
On-site Generated Loads Only

TS Received (ppd)		Nelson Current Sludge Only	Nelson w/BNR Only
Nelson		19500	44200
TWAS		0	0
FOG		0	0
Pass/Fail Criteria		**Scenario A**	**Scenario F**
HRT/SRT	<12 Days	62.0	27.4
VSLR	>0.3	0.08	0.14
SVSLR	>0.16	0.05	0.09
S COD LR	>0.25	0.04	0.07
COD FOG/Total	>0.30	0	0
VS Reduction		65%	60%
TS Leaving	>6-7%	5.1%	6.4%

JOHNSON COUNTY Kansas Wastewater ch2m HDR 45

Will be revised to reflect accepting TWAS with one digester out of service. (reference attachment 4 for updated table)

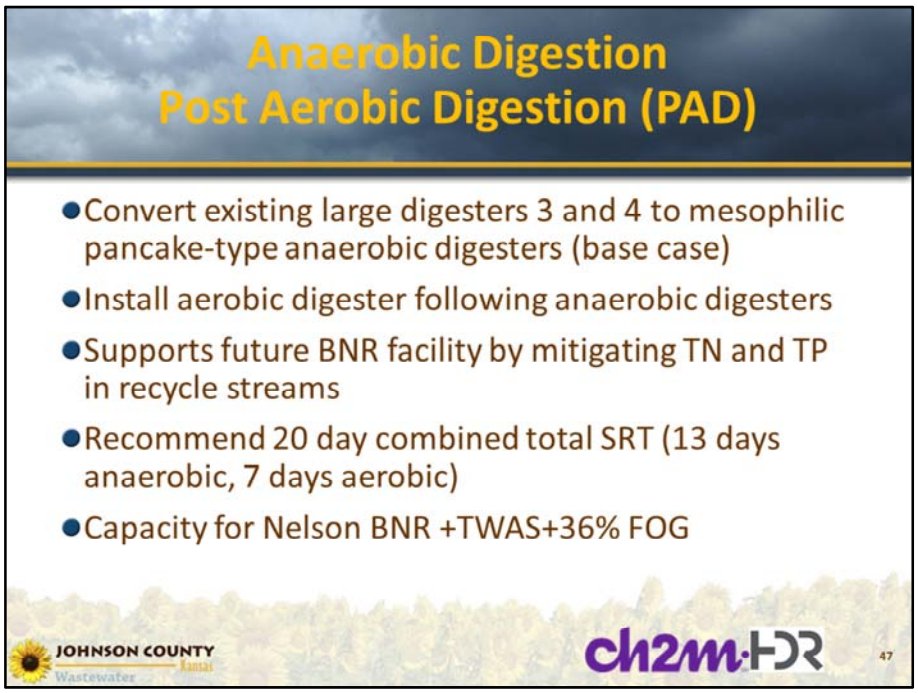
Peak 2 Week – Two Mesophilic w/THP Handles All On-Site, TWAS, and max FOG

TS Received (ppd)		Current, TWAS and max FOG	BNR, TWAS and max FOG
Nelson		21,000	47,600
TWAS		28,000	28,000
FOG		13,000	15,000
Pass/Fail Criteria		**Scenario E2**	**Scenario G2**
HRT/SRT	<12 Days	22	17
VSLR	>0.3	0.12	0.16
SVSLR	>0.16	0.13	0.16
S COD LR	>0.25	.18	.20
COD FOG/Total	>0.30	.3	.3
VS Reduction		65%	64%
TS Leaving	>6-7%	2.8%	3.6%

JOHNSON COUNTY Kansas Wastewater

ch2m HDR

46



Reference attachment 3 for one-page summaries of each alternative.

Max Month – One Mesophilic Digester w/PAD
On-site Generated Loads Only

TS Received (ppd)		Nelson Current Sludge Only	Nelson w/BNR Only
Nelson		19500	44200
TWAS		0	0
FOG		0	0
Fail Criteria		**Scenario A**	**Scenario F**
HRT/SRT	<13/7 Days	27.91/29.3	13.0/13.6
VSLR	>0.15	0.08	0.14
SVSLR	>0.16	0.09	0.17
S COD LR	>0.25	0.17	0.26
COD FOG/Total	>0.30	0	0
VS Reduction		60%	55%
TS Leaving	>3.2%	2.5%	3.1%

JOHNSON COUNTY Kansas Wastewater

ch2m HDR

48

Will be revised to reflect accepting TWAS with one digester out of service. (reference attachment 4 for updated table)

Peak 2 Week – Two Mesophilic w/PAD Handles All On-Site and TWAS (near on max FOG)

TS Received (ppd)		Current, TWAS and max FOG	BNR, TWAS and max FOG
Nelson		21,000	47,600
TWAS		28,000	28,000
FOG		13,000	15,000
Fail Criteria		**Scenario E2**	**Scenario G2**
HRT/SRT	<13/7 Days	17.94/9.4	13.45/7.0
VSLR	>0.15	0.12	0.16
SVSLR	>0.16	0.09	0.11
S COD LR	>0.25	0.15	0.17
COD FOG/Total	>0.30	0.30	0.30
VS Reduction		62%	60%
TS Leaving	>3.2%	2.4%	3.0%

JOHNSON COUNTY Kansas Wastewater ch2m HDR 49

PAD can be added to any other alternative to mitigate sidestream nutrient return to liquid treatment process.
Existing facilities using PAD in Spokane County, Denver, and Boulder.

Digestion Alternative Comparison Summary

	Base Meso	High Solids Meso	Acid-Gas Meso	Thermo	THP	PAD
Handles Current Nelson, TWAS & max FOG ratio	yes	yes	yes	yes	yes	yes
Handles BNR Nelson, TWAS & max FOG ratio	no	no	yes (borderline)	yes	yes	no
if "no", max metro area FOG %	0	0				Slightly less than 40%
VSD % (excl. FOG)	50-55	50-55	55-60	60-65	60-65	60-65
Gas Production	base	same as base	Same as base	+10%	+20%	Same as base

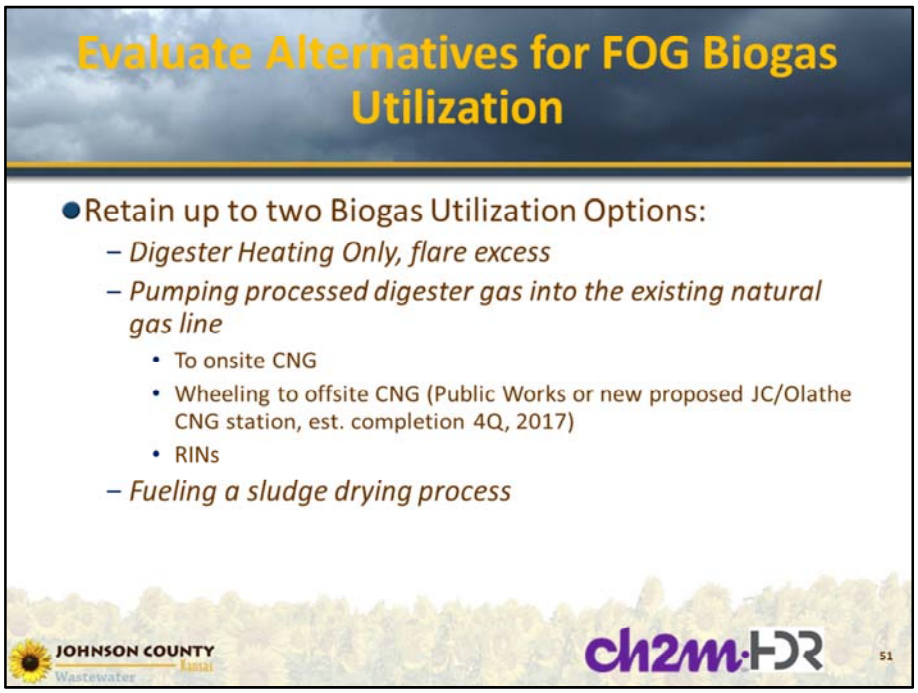
JOHNSON COUNTY Kansas Wastewater

ch2m HDR

50

High solids meso was eliminated as not feasible.
THP was eliminated from study. JCW will review the option to add THP at a future date.
Thermo was eliminated on the grounds that a strict temperature requirement may be too difficult to maintain.
For the short term: JCW wants to explore the base Meso conversion of 2 existing digesters.
For the long term: JCW is interested in:

a)Base 2 meso digesters + 1 additional digester
b)Base 2 meso digesters + PAD/Acid-Gas



Eliminated:

- Onsite CNG, due to insufficient demand on-site
- RINs, to be consistent with Tomahawk evaluation, which assumed that RINs will cease to exist after 2022
- Fueling sludge drying process options, due to absence of drivers to produce Class A at this time

In the short term JCW expects to flare the excess biogas. For the long term, JCW would like to explore the following two Biogas Utilization Options:

- Wheeling to offsite CNG
- Cogeneration (returned to list of options due to JCW decision to install cogeneration at Tomahawk)

Annual Average Biogas Production
Mesophilic Digestion

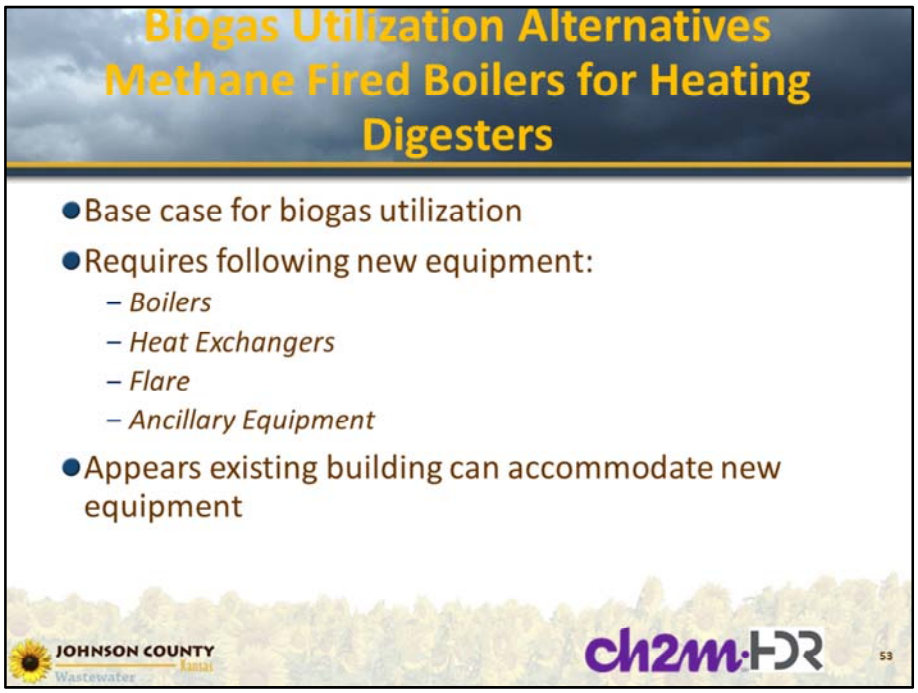
	Nelson Current Sludge Only	Nelson Current Sludge Plus All TWAS	Nelson Current Sludge, TWAS, max FOG
Digester Gas Produced SCF/day	93,000	183,000	297,000
Assume 50% excess	46,000	91,000	149,000

	Nelson BNR Sludge Only	Nelson BNR Sludge Plus All TWAS	Nelson BNR Sludge, TWAS & max FOG
Digester Gas Produced SCF/day	153,000	220,000	281,000
Assume 50% excess	76,000	110,000	140,000

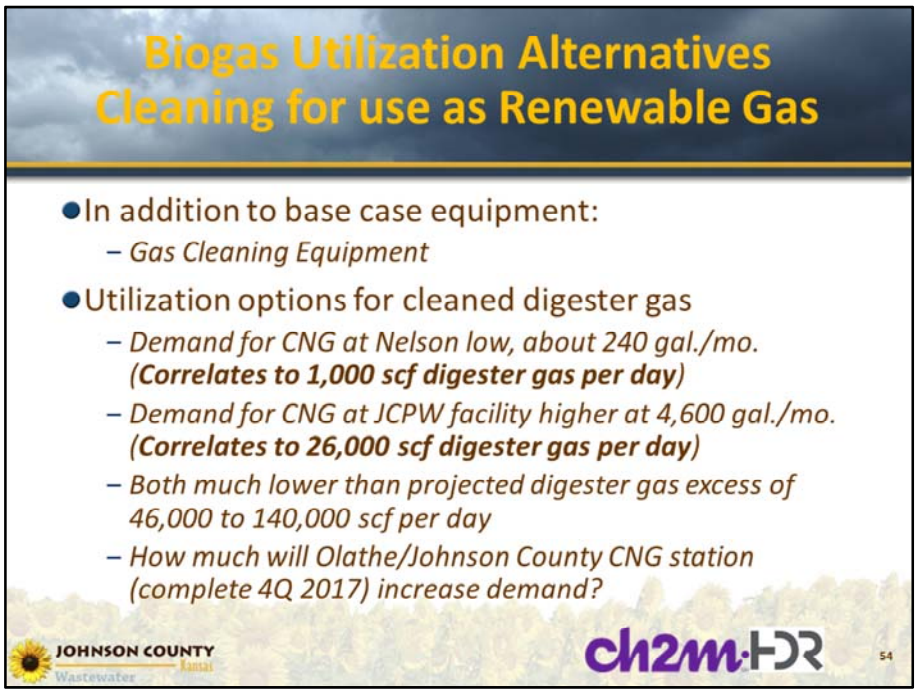
JOHNSON COUNTY Kansas Wastewater

ch2m HDR

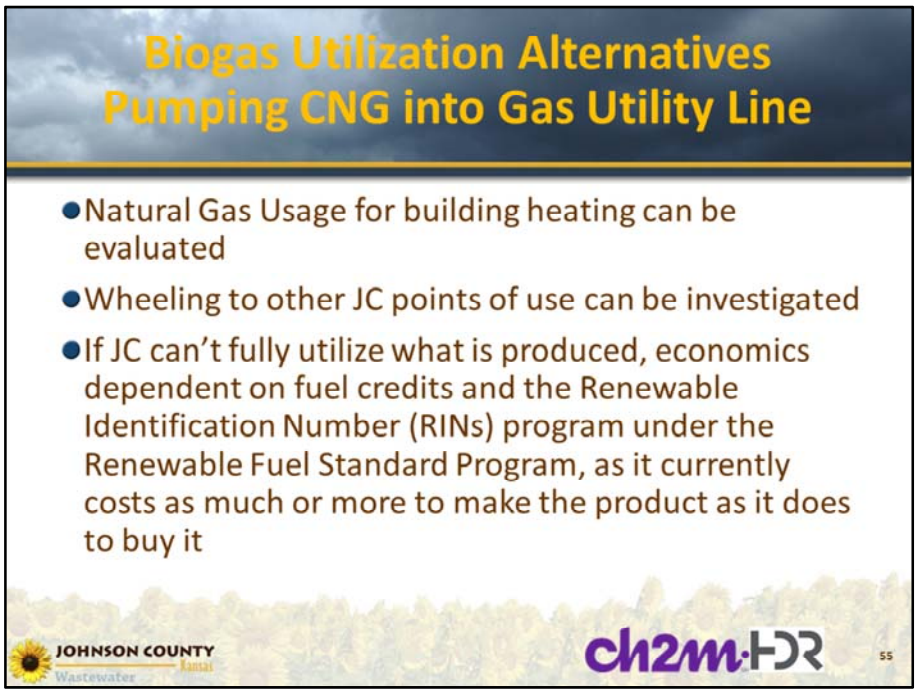
52



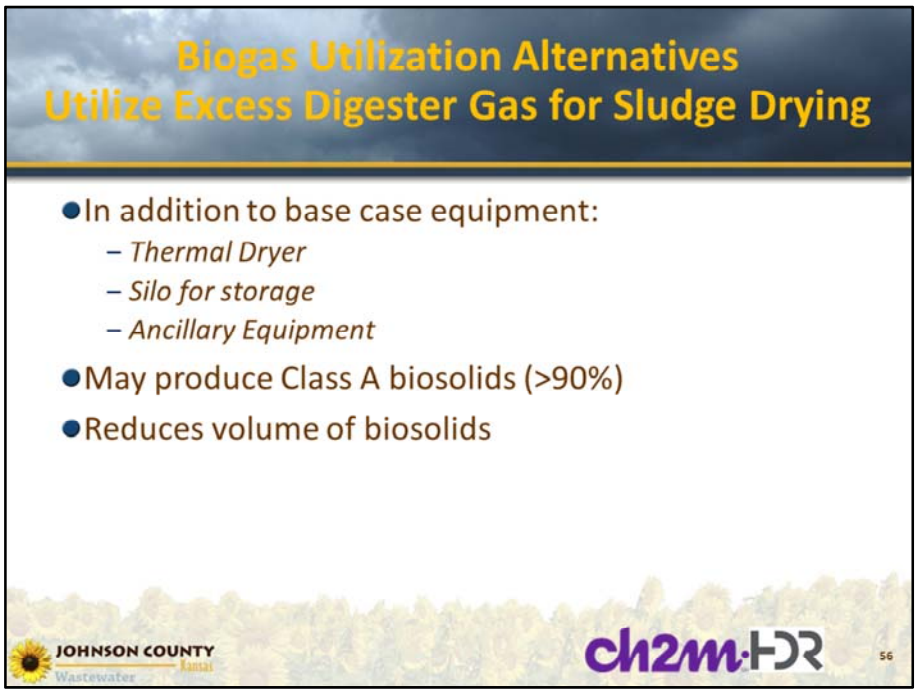
Reference attachment 3 for one-page summaries of each alternative.



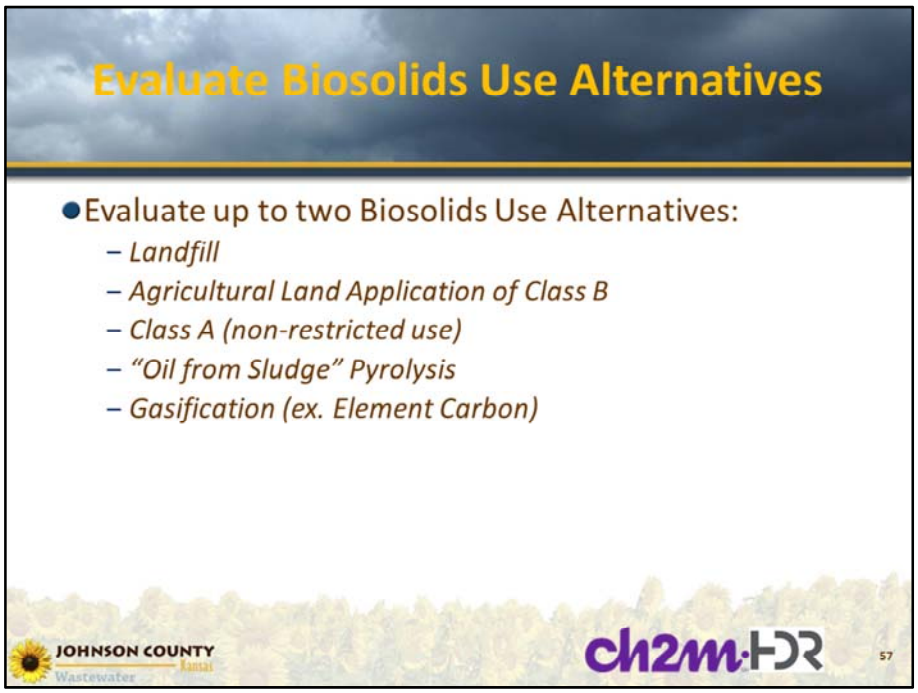
New CNG station demand: Johnson County plans to convert half of their buses to CNG. Olathe plans to convert all garbage trucks to CNG. Reference attachment 3 for one-page summaries of each alternative.



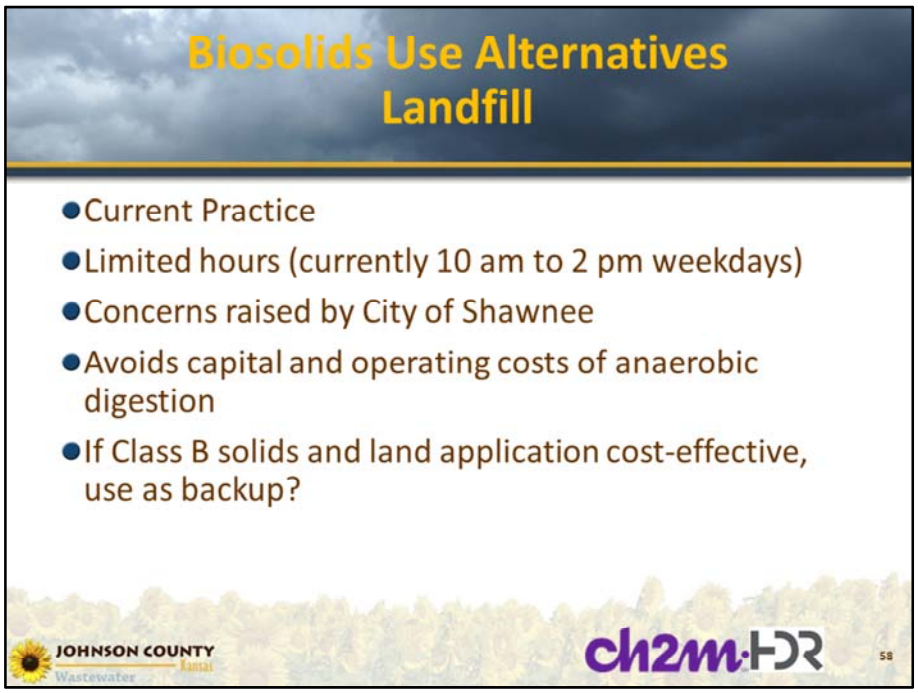
Reference attachment 3 for one-page summaries of each alternative.



Not retained. Replaced with cogeneration as Tomahawk will utilize cogeneration (was noted that Tomahawk does not have a CNG station). Reference attachment 3 for one-page summaries of each alternative.



Eliminated: Class A biosolids, "oil from sludge" pyrolysis, and gasification. Pyrolysis and gasification are still technologies under development and are not cost competitive at this time. Reference attachment 3 for one-page summaries of each alternative.



Yes, assume can be used as backup to a Class B land application program.

Biosolids Use Alternatives
Land Application of Class B Biosolids

- Dewatered, digested, Class B biosolids would be land applied by contract haulers
- Similar to practice at Middle Basin
- Would require anaerobic digestion at Nelson Complex
- Cost comparison of land application to landfill may be less important, as land application is likely more reliable

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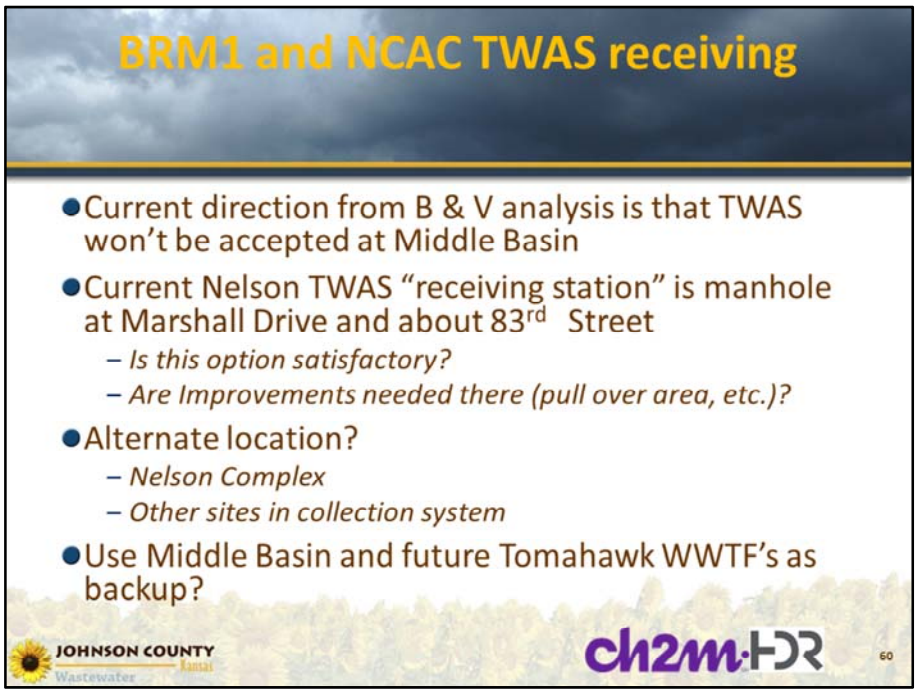
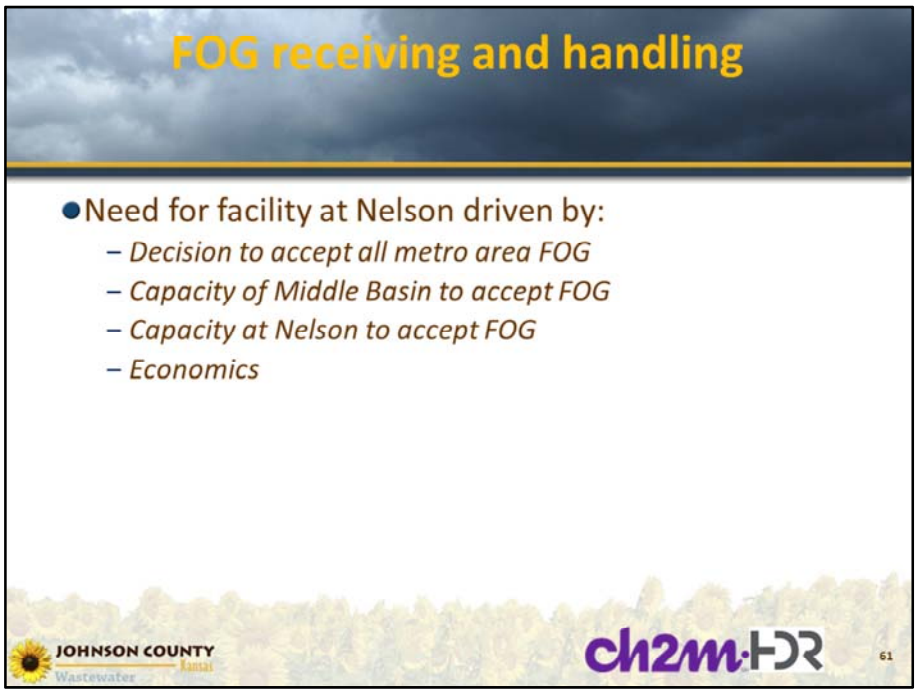
59



On-site TWAS unloading should be developed for pricing. May consider using Digesters 1 and 2 for unloading/holding.



FOG receiving should be developed for pricing to provide redundancy to Middle Basin and as much FOG handling capacity as is feasible.

Nelson WWTF Identification and Definition of Alternatives-High Level Screening

- Select maximum of two Alternatives per process to retain for Detailed Evaluation:
  - *BRM1 and NCAC TWAS receiving*
  - *FOG waste receiving and handling*
  - *Anaerobic digestion*
  - *Biogas utilization*
  - *Biosolids use*

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62

CH2M will offer potential dates in July for next workshop.

Closing and Next Steps

- Questions?
- Concerns?
- Was this meeting of value?
- Other feedback?

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64

Final Thoughts

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65

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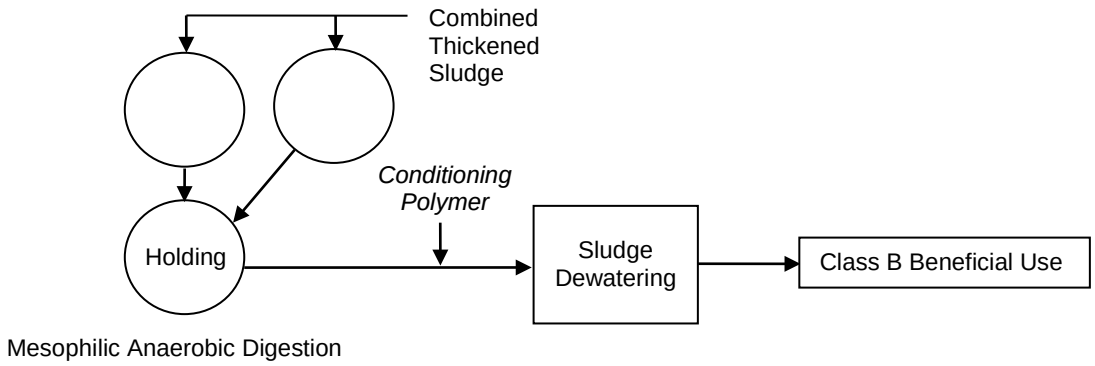
2030	**Nelson Only – Current WWTP**	**Nelson (current) plus all TWAS into Collection System**	**Nelson (current) plus all TWAS to solids blend tank**	**Nelson (current) plus all FOG**	**Nelson (current) plus max allowed FOG**	**Nelson (current) plus all TWAS and all FOG**	**Nelson (current) plus all TWAS and max FOG to blend tank**	**Nelson Only – BNR ("C" series from Nutrient Study)**	**Nelson (BNR) plus all TWAS and all FOG**	**Nelson (BNR) plus all TWAS and max FOG**	**Nelson (BNR) plus all TWAS to solids blend tank**
AA	A	B	C	D	D2	E	E2	F	G	G2	G3
Nelson	15,000 ppd 4.5% TS 75% VS	15,000 ppd 3.5% TS 75% VS	15,000 ppd 4.5% TS 75% VS	15,000 ppd 4.5% TS 75% VS		15,000 ppd 4.5% TS 75% VS		34,000 ppd 5.4% TS 60% VS	34,000 ppd 5.4% TS 60% VS		
TWAS (1)		14,000 ppd 3.5% TS 75% VS	20,000 ppd 4.3% TS 75% VS			20,000 ppd 4.3% TS 75% VS			20,000 ppd 4.3% TS 75% VS		
FOG (2)				27,600 ppd 7.0% TS 87% VS		27,600 ppd 7.0% TS 87% VS			27,600 ppd 7.0% TS 87% VS		
Total	**15,000 ppd**	**29,000 ppd**	**35,000 ppd**	**42,600 ppd**		**62,600 ppd**		**34,000 ppd**	**81,600 ppd**		
MM											
Nelson	19,500 ppd 4.5% TS 75% VS	19,500 ppd 3.5% TS 75% VS	19,500 ppd 4.5% TS 75% VS	19,500 ppd 4.5% TS 75% VS	19,500 ppd 4.5% TS 75% VS	19,500 ppd 4.5% TS 75% VS	19,500 ppd 4.5% TS 75% VS	44,200 ppd 5.4% TS 60% VS	44,200 ppd 5.4% TS 60% VS	44,200 ppd 5.4% TS 60% VS	44,200 ppd 5.4% TS 60% VS
TWAS (1)		18,200 ppd 3.5% TS 75% VS	26,000 ppd 4.3% TS 75% VS			26,000 ppd 4.3% TS 75% VS	26,000 ppd 4.3% TS 75% VS		26,000 ppd 4.3% TS 75% VS	26,000 ppd 4.3% TS 75% VS	26,000 ppd 4.3% TS 75% VS
FOG (2, 3)				33,100 ppd 7.0% TS 87% VS	6,000 ppd 7.0% TS 87% VS	33,100 ppd 7.0% TS 87% VS	12,000 ppd 7.0% TS 87% VS		33,100 ppd 7.0% TS 87% VS	13,600 ppd 7.0% TS 87% VS	
Total	**19,500 ppd**	**37,700 ppd**	**45,500 ppd**	**52,600 ppd**	**25,500 ppd**	**78,600 ppd**	**57,500 ppd**	**44,200 ppd**	**103,300 ppd**	**83,800 ppd**	**70,200 ppd**

Digestion Process Alternatives

All digestion alternatives will start with the base case of converting the existing large digesters 3 and 4 to mesophilic pancake-type anaerobic digesters. The digestion options will be screened for their ability to produce a stabilized sludge product capable of meeting the 40 CFR Part 503 Class B requirements for land application.

Base Case – Conversion of Digesters 3 and 4 to Mesophilic



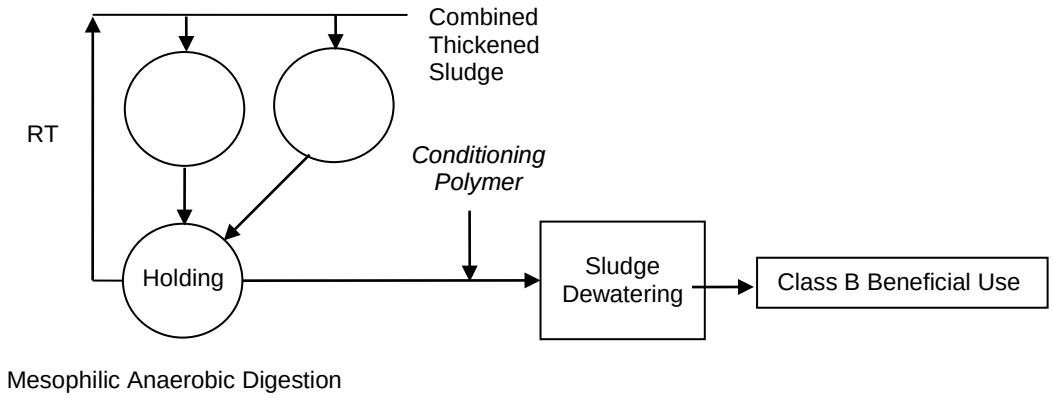
The base case anaerobic digestion facility would consist of converting the existing large digesters 3 and 4 to mesophilic pancake-type anaerobic digesters, to be followed by existing sludge dewatering. The digesters must provide the solids retention time required for a Class B biosolids product (minimum 15 days). Virtually all new ancillary anaerobic digestion equipment would be needed.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Moderate capability to deal with fluctuations in flow and load. Susceptible to process upset. Fecal coliform “regrowth” has been identified with this process in combination with high-solids centrifuges.
Adaptability/Phasing	Not suitable for producing a Class A product. Minimal potential for project phasing.
Proven Experience	Highly proven technology.
Staffing/Multiple Processes	Significant additional staff time will be required to resume operating a solids stabilization process.
Sidestream Impacts	Additional sidestreams flows due to addition of new process.
Land/Building Requirements	Existing tanks are in good shape, requiring new lids, gas systems and piping. The existing digester building appears to be adequately sized, some modifications may be required to house ancillary equipment.
Social Impacts	Social impacts may include reduced odors from dewatering digested, not raw biosolids. Provides for Class B beneficial use of biosolids.

Comments:

Methane gas produced by the anaerobic digestion process will be used to heat the digesters.

High Solids Mesophilic



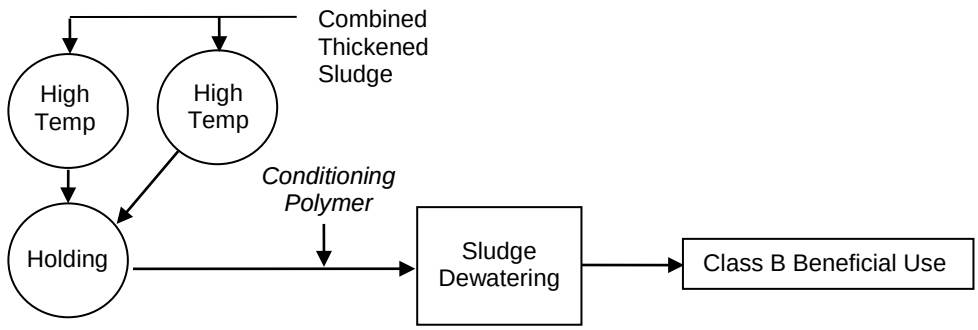
The base case mesophilic large anaerobic digesters 3 and 4 would be modified to include Recuperative Thickening (RT) or additional pre-thickening of feed streams. The digesters must provide the solids retention time required for a Class B biosolids product, and with higher solids feed, SRT achieved from the two digesters is enhanced, providing additional capacity from the same volume. Virtually all new ancillary anaerobic digestion equipment would be needed.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Moderate capability to deal with fluctuations in flow and load. Susceptible to process upset. Fecal coliform “regrowth” has been identified with this process in combination with high-solids centrifuges.
Adaptability/Phasing	Not suitable for producing a Class A product. Minimal potential for project phasing.
Proven Experience	Proven technology.
Staffing/Multiple Processes	Significant additional staff time will be required to resume operating a solids stabilization process. Additional staff time would be required beyond the base case to operate the RT or thickening processes.
Sidestream Impacts	Additional sidestream flows due to addition of new process.
Land/Building Requirements	Existing tanks are in good shape, requiring new lids, gas systems and piping. The existing digester building appears to be adequately sized, some modifications may be required to house ancillary equipment. Additional space would be needed for RT or thickening processes, but the space within the existing building may be sufficient.
Social Impacts	Social impacts may include reduced odors from dewatering digested, not raw biosolids. Provides for Class B beneficial use of biosolids.

Comments:

Methane gas produced by the anaerobic digestion process will be used to heat the digesters.

Thermophilic Anaerobic Digesters



Thermophilic Anaerobic Digesters

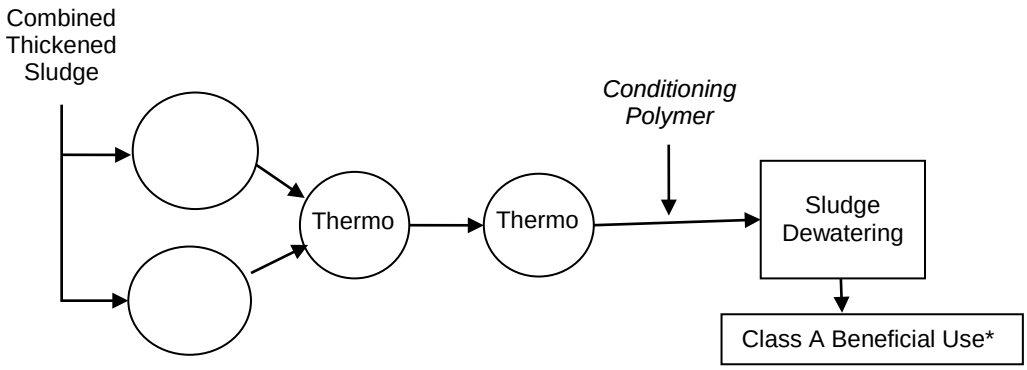
Instead of converting the two existing large digester tanks 3 and 4 to mesophilic anaerobic digesters, convert them to thermophilic digesters. Operate the two tanks in parallel, identical to the base mesophilic case. Due to the higher temperatures, the solids retention time required for a Class B biosolids product is reduced to 8 days. The higher rate process can also accept 20-50% higher loading rates than the mesophilic base case. Virtually all new ancillary anaerobic digestion equipment would be needed.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Moderate capability to deal with fluctuations in flow and load. More susceptible to process upset than base case. Thermophilic digesters form siloxane in digester gas, which precipitates on gas handling equipment reducing service life. Fecal coliform “regrowth” has been experienced in combination with high-solids centrifuges.
Adaptability/Phasing	May require adjustment to dewatering polymer type and dose.
Proven Experience	Proven process with batch operation. Some experience with staged operation (testing would be required for Class A designation).
Staffing/Multiple Processes	Significant additional staff time will be required for the addition of a new complex solids process. Increased maintenance requirements for siloxane removal.
Sidestream Impacts	Large sidestream impact. Process generates significantly more ammonia than mesophilic operation.
Land/Building Requirements	While existing tanks are in good shape, additional structural modifications could be required to prepare them for the higher temperature conditions. Additional space may be needed for larger heating and gas handling systems, but existing building likely adequate.
Social Impacts	Process has high potential to generate odors. Increased volatile solids reduction may provide slight reduction in truck traffic. Final product is more stabilized than mesophilic product.

Comments

Higher VSS reduction will create greater gas production. However, more gas will also be required to meeting the digester heating requirements. More robust structural modifications, pressure relief and other valves, mixing equipment, heating and heat exchange systems would be required.

Multi-Stage Thermophilic Anaerobic Digestion



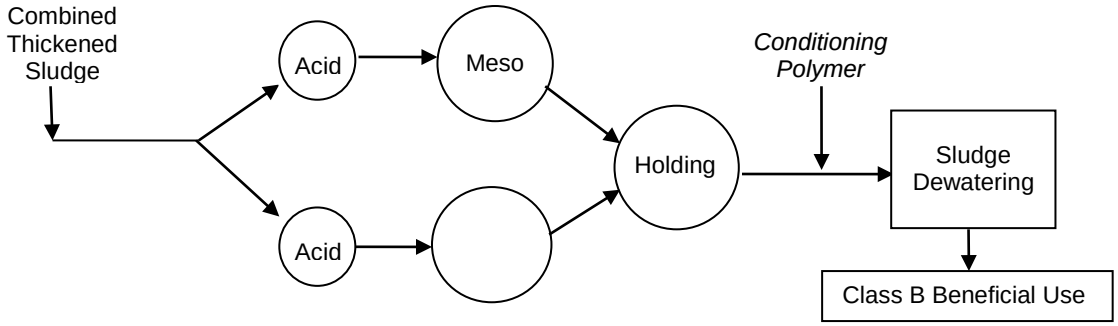
Convert the two large digester tanks 3 and 4 to thermophilic digesters to be first stage digestion (in parallel). Also convert the two smaller digester tanks 1 and 2 to thermophilic digesters and operate them in series after the two larger, parallel tanks. The multi-stage process would likely produce a Class A product, but Class A would need to be proven by monitoring and testing. Modifications to the heating and gas handling systems for the converted digesters would be required.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Moderate capability to deal with fluctuations in flow and load. More susceptible to process upset. Thermophilic digesters form siloxane in digester gas, which precipitates on gas handling equipment reducing service life. Fecal coliform “regrowth” has been experienced in combination with high-solids centrifuges.
Adaptability/Phasing	Future phasing to Class A requirements is a potential with delaying addition of the 2 smaller tanks in series. May require adjustment to dewatering polymer type and dose.
Proven Experience	Limited experience with staged operation (testing for Class A).
Staffing/Multiple Processes	Significant additional staff time will be required for the addition of a new complex solids process. Further increase in staff time for two additional tanks in series and potential testing if proving Class A was pursued. Increased maintenance requirements for siloxane removal.
Sidestream Impacts	Large sidestream impact. Process generates more ammonia than mesophilic operation.
Land/Building Requirements	While existing tanks are in good shape, additional structural modifications could be required to prepare them for the higher temperature conditions. Additional space for larger heating and gas handling systems, but existing building may be adequate.
Social Impacts	Process has high potential to generate odors. Increased volatile solids reduction may provide slight reduction in truck traffic. Final product is more stabilized than mesophilic product, and potentially Class A.

Comments

Higher VSS reduction will create greater gas production. However, more gas will also be required to meeting the digester heating requirements. More robust structural modifications, pressure relief and other valves, mixing equipment, heating and heat exchange systems would be required.

Acid-Gas Phase Digestion Process

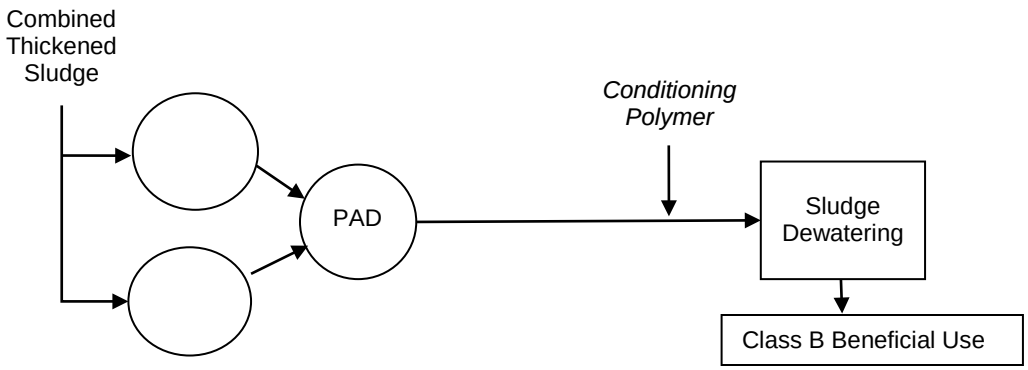


Modify the small digesters 1 and 2 to acid-phase digesters. Convert large digesters 3 and 4 to mesophilic anaerobic digesters. The digesters must provide the solids retention time required for a Class B biosolids product, and with the additional acid phase volume, total capacity for accepting TWAS and FOG is increased. Virtually all new ancillary anaerobic digestion equipment would be needed.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Can reasonably handle fluctuations in flow and loads. Separate unit processes facilitates optimization of organism growth and reduces foam production. No data has been provided for fecal coliform “regrowth” under this operation.
Adaptability/Phasing	Decanting off Acid Phase digesters offers potential VFAs to future BNR liquid treatment stream.
Proven Experience	Limited full-scale experience.
Staffing/Multiple Processes	Significant additional staff time will be required for the addition of a new complex solids process. Four, rather than two digesters would require additional staff time.
Sidestream Impacts	Large sidestream impact. Process generates more ammonia than standard mesophilic operation.
Land/Building Requirements	While existing tanks are in good shape, additional structural modifications could be required to prepare them for the acid conditions. Additional space for heating and gas handling systems, similar to base mesophilic.
Social Impacts	Process has potential to generate odors although less than thermophilic operation. Increased volatile solids reduction may provide moderate reduction in truck traffic.

Comments
Redundancy would be provided by having two acid phase and two mesophilic digesters.

Post Aerobic Digestion (PAD)



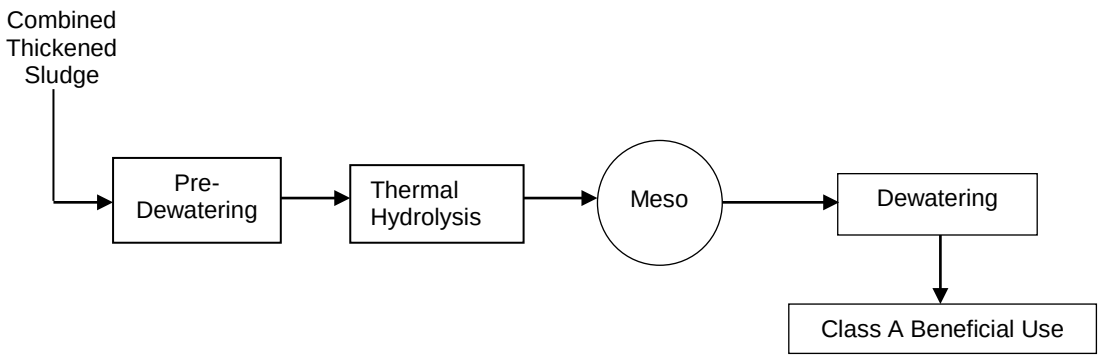
Following the two large digester tanks 3 and 4 operating as mesophilic digesters (in parallel), add a new post-aerobic digestion (PAD) step. Following anaerobic digestion with PAD eliminates the nutrient recycle (TN and TP) from the sidestreams through nitrification and denitrification of the ammonia produced in anaerobic digestion and precipitation of the phosphorus as struvite that then remains with the utilized biosolids. It also increases the total digestion HRT/SRT and provides additional volatile solids reduction.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Potential for foaming, which can be mitigated with SCADA monitoring and control. Doubles as additional solids storage tank (variable level)
Adaptability/Phasing	Implementation could be delayed and implementation integrated with BNR improvements. Achieves TN removal and TP removal without addition of chemicals. May require adjustment to dewatering polymer type and dose.
Proven Experience	Proven performance.
Staffing/Multiple Processes	Significant additional staff time will be required for the addition of a new complex solids process. Further increase in staff time for two additional tanks in series and potential testing if proving Class A was pursued. Increased maintenance requirements for siloxane removal.
Sidestream Impacts	Integral part of nutrient removal system, and possible nitrifier bioaugmentation.
Land/Building Requirements	Additional space for new PAD tank. Aeration equipment may be able to be located in existing building.
Social Impacts	Reduced odors in final product for land application. Increased volatile solids reduction may provide slight reduction in truck traffic. Final product is more stabilized than base mesophilic product.

Comments

Higher VSS reduction does not result in more gas production. Increased power requirements for aeration system.

Alternative: Thermal Hydrolysis Process



The Thermal Hydrolysis Process (THP) breaks down organic matter in primary and waste activated sludges, improves the digestibility of solids, increases biogas production, allows for improved dewaterability, and lowers cake production. It is primarily used as a pretreatment step prior to anaerobic digestion, and may include alternate arrangements such as treating TWAS only. THP thermally hydrolyses wastewater solids by processing them at 320 ^{o}F and 90 psi with pressured steam for a minimum of 20 minutes, followed by a rapid expansion which further disintegrates biomass. The process is intended to solubilize COD, thereby significantly reducing sludge viscosity and making loading the digesters at up to twice the rate of normal digesters possible.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Very flexible to varying load conditions with batches normally designed for 30 minutes and the flexibility to reduce the batch time to 20 minutes and still meet performance objectives. Increases dewaterability producing a dried biosolid product that is approximately 10 percent drier resulting is less product for final disposal.
Adaptability/Phasing	If all biosolids flows are fed to the process, produces a Class A product. Minimal potential for project phasing.
Proven Experience	Highly proven technology, but only a few systems are either operational or under construction in the US. More than 50 are in service in Europe.
Staffing/Multiple Processes	Additional staff time will be required for process. Certification of at least one operator in high-pressure steam operations will likely be required.
Sidestream Impacts	Although side stream flows are reduced with reduced flows to the digesters, the ammonia concentrations are increased by approximately 30 percent. Overall mass loading of ammonia in sidestream does not change.
Land/Building Requirements	Overall land requirements approximately equal to adding an additional digester.
Social Impacts	Social benefits increased with reduced biosolids product and increased biogas production available for beneficial reuse. Increases beneficial use of biosolids with Class A quality.

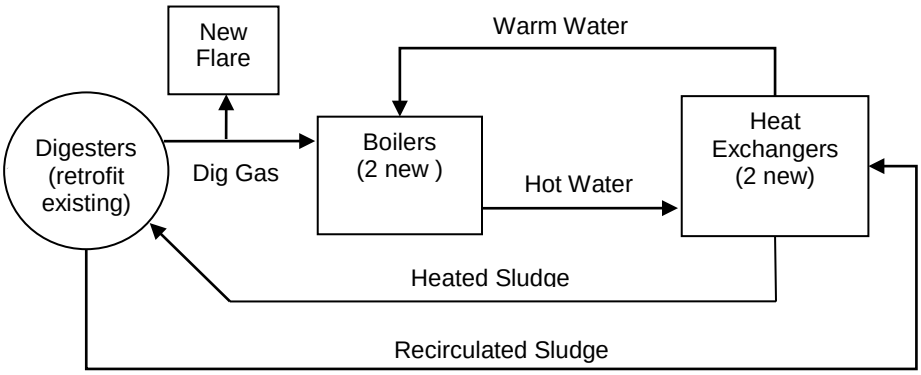
Comments:

THP increases digester gas produced by the anaerobic digestion process by 20-30 percent over standard mesophilic digestion.

Digester Gas Utilization Alternatives

New boilers will be installed, as appropriate, for the selected anaerobic digestion option. The base case assumes that anaerobic digestion will be installed and digester gas handling facilities will be needed. The following base case and three alternatives were identified for digester gas utilization at the Nelson Complex.

Methane Gas Fired Boilers for Heating Digesters



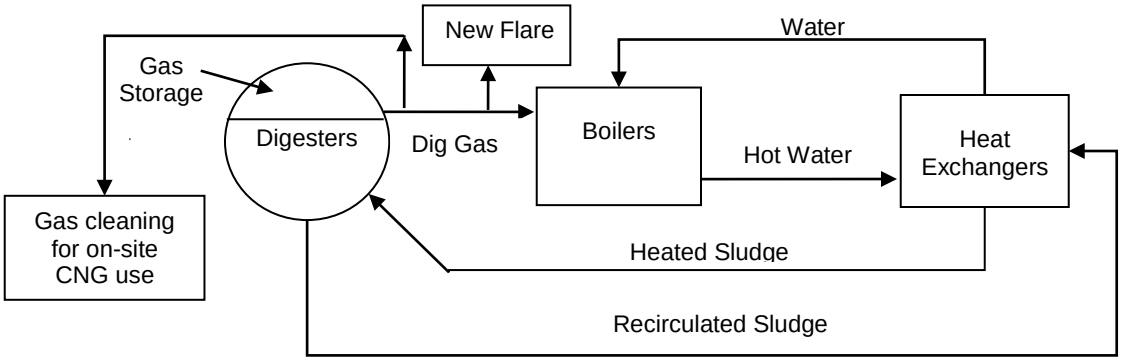
Boilers provide heat to maintain digester temperatures.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Can handle fluctuations in flow and load through flame. Can handle minimal process upset. Major upsets may affect digester gas delivery to boilers.
Adaptability/Phasing	Not applicable.
Proven Experience	Well proven technology.
Staffing/Multiple Processes	This is a new process for the Nelson facility, but is an existing process at Middle Basin with which the operators are familiar.
Sidestream Impacts	Not applicable.
Land/Building Requirements	New equipment will be housed in the existing building.
Social Impacts	Makes use of some digester waste gas.

Comments

New flare facility will be required.

Onsight Compressed Natural Gas (CNG)



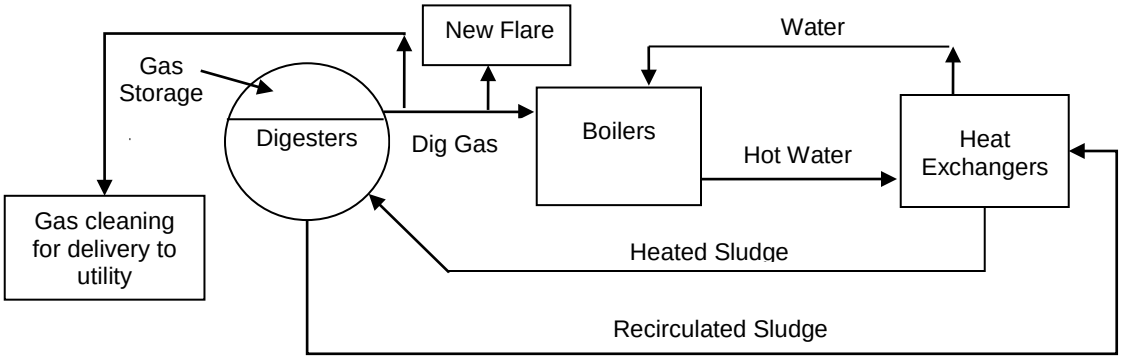
Digester gas in excess of digester heating needs would be cleaned and pumped to the existing CNG station on the northeast corner of the Nelson Complex facility. As appropriate, enhancements to the CNG facility could be made to facilitate usage. Boilers would still be required to provide heat to maintain digester temperatures.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Can handle fluctuations in flow and load. Can handle minimal process upset. Major upsets may affect digester gas delivery to equipment.
Adaptability/Phasing	Maximizes use of existing CNG facility.
Proven Experience	Well proven technology.
Staffing/Multiple Processes	Increased operational time will be required for new process. Multiple processes will require balancing of digester gas use.
Sidestream Impacts	Not applicable.
Land/Building Requirements	The existing digester building should be able to accommodate this equipment. If modifications are made to the existing CNG station, the site is limited.
Social Impacts	Makes greater use of digester waste gas and reduces flaring of gas.

Comments

Current usage at the Nelson CNG facility is relatively low, at about 240 gallons per month, compared to the Public Works facility, at 4,600 gallons per month. Consequently, there is limited demand for CNG at Nelson.

Pumping CNG into Gas Utility Line

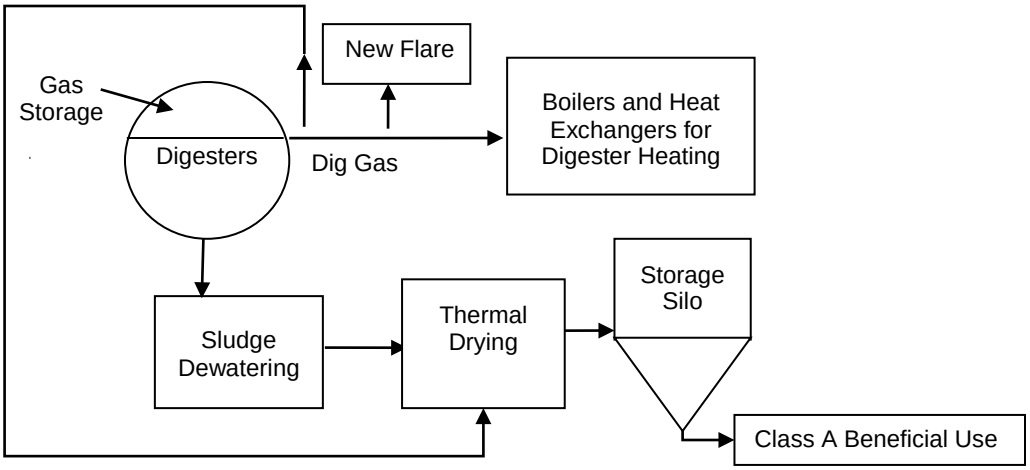


Digester gas in excess of digester heating needs would be cleaned and pumped to the existing utility natural gas line serving the Nelson Complex facility. Boilers would still be required to provide heat to maintain digester temperatures.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Can handle fluctuations in flow and load. Can handle minimal process upset. Major upsets may affect digester gas delivery to equipment.
Adaptability/Phasing	Can be used or not, as digester gas is available.
Proven Experience	Well proven technology.
Staffing/Multiple Processes	Increased operational time will be required for the new gas cleaning process. In contrast to CNG, less equipment to maintain.
Sidestream Impacts	Not applicable.
Land/Building Requirements	Not applicable.
Social Impacts	Makes greatest use of digester waste gas and minimizes flaring of gas.

Comments Economics are highly dependent on the Renewable Identification Number (RINs) program under the Renewable Fuel Standard Program, as it currently costs as much or more to make the product as it does to buy it.

Utilize Excess Digester Gas for sludge drying



Digester gas in excess of digester heating needs would be utilized for sludge drying. Boilers would still be required to provide heat to maintain digester temperatures.

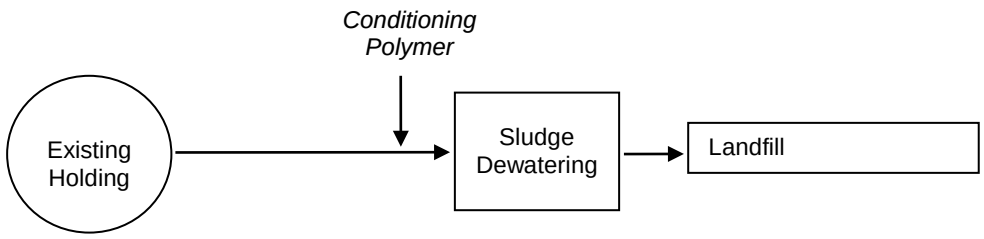
ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Can handle fluctuations in flow and load. Can handle minimal process upset. Major upsets may affect digester gas delivery to equipment.
Adaptability/Phasing	Maximizes use of digester gas while also producing Class A biosolids for alternate disposal options.
Proven Experience	Well proven technology.
Staffing/Multiple Processes	Increased operational time will be required for new process. Multiple processes will require balancing of digester gas use.
Sidestream Impacts	Not applicable.
Land/Building Requirements	Likely requires additional building space.
Social Impacts	Makes greater use of digester waste gas and reduces flaring of gas.

Comments

Biosolids Utilization Alternatives

Two alternatives for biosolids utilization will be evaluated: the current landfill alternative and Class B land application, similar to the process used at the Douglas L. Smith Middle Basin (DLSMB) facility.

Landfill

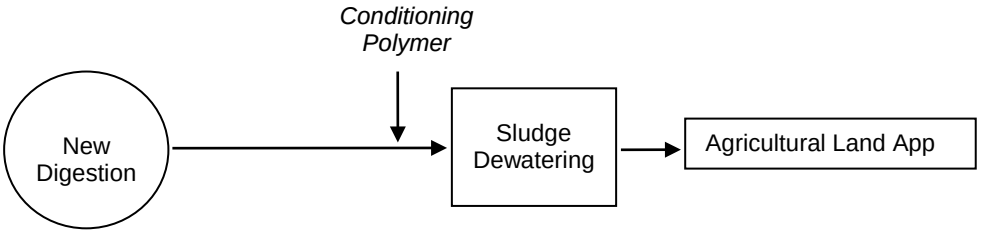


Dewatered biosolids will continue to be sent the Waste Management Landfill in Shawnee.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Limited hours (currently 10 am to 2 pm weekdays) imposed by the landfill pose considerable challenges in addressing holidays, variations in biosolids production, etc.
Adaptability/Phasing	Not applicable.
Proven Experience	Well proven technology.
Staffing/Multiple Processes	No change in current staffing.
Sidestream Impacts	No change in sidestream impacts.
Land/Building Requirements	No change in land and building requirements.
Social Impacts	No beneficial reuse of biosolilds. Odors at landfill have been attributed to biosolids disposal by JCW and others, among other potential causes.

Comments Landfill management and the City of Shawnee have decreased flexibility for disposal in the landfill. This option would avoid the capital and operating costs of anaerobic digestion.

Land Application of Class B Biosolids

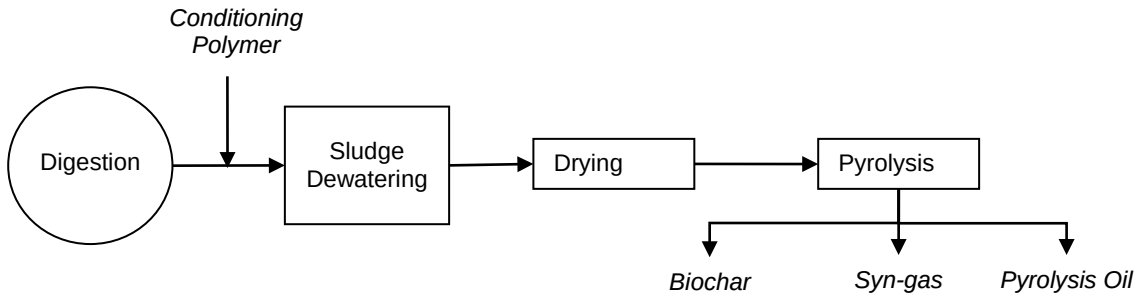


Dewatered, digested, Class B biosolids would be land applied by contract haulers, similar to the practice at the DLSMB facility. This option would require that anaerobic digestion be installed at the Nelson Complex facility.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	The experience at DLSMB indicates this practice can accommodate variations in weather conditions and solids production.
Adaptability/Phasing	Can be scaled up or down with solids production levels.
Proven Experience	Well proven technology.
Staffing/Multiple Processes	Changes in current staffing are related to the digestion process.
Sidestream Impacts	Sidestream impacts are related to the digestion process.
Land/Building Requirements	No change in land and building requirements.
Social Impacts	Beneficial reuse of biosolilds. Elimination of JCW biosolids as a potential source of odors at the landfill.

Comments Cost comparison of this alternative to the landfill alternative may be less important, as land application is likely a more reliable alternative.

Biosolids Pyrolysis: Oil from Sludge

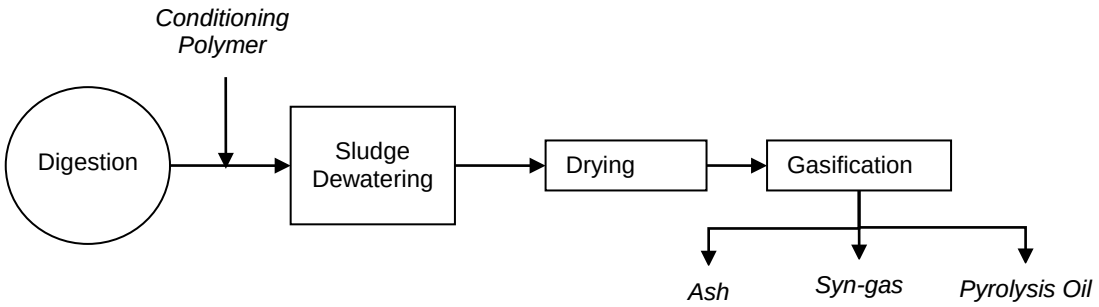


Dewatered biosolids will be dried and converted into biochar, pyrolysis oil, and syn-gas. Pyro-oil and gas directed to Digester for co-digestion with plant sludge. High temperature (250 –800 deg C), anoxic or near anoxic process.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Requires significant capital investment for equipment which may prevent ability to acquire redundant equipment. Limited flexibility – must keep feed stream to pyrolysis consistent. High performance risk.
Adaptability/Phasing	Not applicable.
Proven Experience	Limited existing facilities in the US
Staffing/Multiple Processes	Increased operational time will be required for new process.
Sidestream Impacts	No change in sidestream impacts.
Land/Building Requirements	Will require additional space for equipment.
Social Impacts	Beneficial use of sludge. Elimination of JCW biosolids as a potential source of odors at the landfill. Produces biochar to commercialize recognizing higher value as a fertilizer/soil amendment.

Comments Significantly higher cost per wet ton when compared to land application.

Gasification Competing with Land Application



Dewatered biosolids will be dried and converted into pyrolysis oil and syn-gas. Pyro-oil and gas directed to Digester for co-digestion with plant sludge, remaining char is converted to additional syngas. High temperature (400 –1600 deg C) process that uses minimal oxygen.

ATTRIBUTE	COMMENTS
Flexibility/Performance Risk	Requires significant capital investment for equipment which may prevent ability to acquire redundant equipment.
Adaptability/Phasing	Not applicable.
Proven Experience	First generation technology
Staffing/Multiple Processes	Increased operational time will be required for new process.
Sidestream Impacts	No change in sidestream impacts.
Land/Building Requirements	Will require additional space for equipment.
Social Impacts	Beneficial use of sludge. Elimination of JCW biosolids as a potential source of odors at the landfill.

Comments Occurs at a higher temperature than pyrolysis. Eliminates virtually all of the carbon in the feedstock

Max Month – One Mesophilic Digester On-site Generated Loads plus TWAS

TS Received (ppd)		Nelson Current Sludge +TWAS	Nelson w/BNR +TWAS
Nelson		19500	44200
TWAS		26000	26000
FOG		0	0
Pass/Fail Criteria		**Scenario C**	**Scenario G3**
HRT/SRT	<15 Days	11.7	7.9
VSLR	>0.15	0.18	0.24
SVSLR	>0.16	0.16	0.23
S COD LR	>0.25	0.25	0.34
COD FOG/Total	>0.30	0	0
VS Reduction		46%	46%
TS Leaving	>3.2%	2.9%	3.2%

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1

Max Month – One Mesophilic Digester
Higher Solids NOT FEASIBLE

TS Received (ppd)		Nelson Current Sludge +TWAS	Nelson w/BNR +TWAS
Nelson		19500	44200
TWAS		26000	26000
FOG		0	0
Pass/Fail Criteria		**Scenario C**	**Scenario G3**
HRT/SRT	<15 Days	13.2	7.9
VSLR	>0.15	0.18	0.24
SVSLR	>0.16	0.14	0.23
S COD LR	>0.25	0.2	0.34
COD FOG/Total	>0.30	0	0
VS Reduction		46%	46%
TS Leaving	>3.2%	3.2%	3.2%

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2

Higher solids could not improve HRT/SRT under current Nelson plant sludge production w/TWAS to meet 15 day criteria without violating criteria for max solids concentration leaving digestion.

Max Month – One Acid/Mesophilic Train On-site Generated Loads plus TWAS

TS Received (ppd)		Nelson Current Sludge +TWAS	Nelson w/BNR +TWAS
Nelson		19500	44200
TWAS		26000	26000
FOG		0	0
Pass/Fail Criteria		**Scenario C**	**Scenario G3**
HRT/SRT	<1.5/12 Days	1.9/11.7	1.3/7.9
VSLR	>0.15	0.15	0.20
SVSLR	>0.16	0.15	0.22
S COD LR	>0.25	0.24	0.32
COD FOG/Total	>0.30	0	0
VS Reduction		51%	51%
TS Leaving	>3.2%	2.7%	3.1%

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3

Max Month – One Thermophilic Digester On-site Generated Loads plus TWAS

TS Received (ppd)		Nelson Current Sludge +TWAS	Nelson w/BNR +TWAS
Nelson		19500	44200
TWAS		26000	26000
FOG		0	0
Pass/Fail Criteria		**Scenario C**	**Scenario G3**
HRT/SRT	<8 Days	11.7	8.5
VSLR	>0.3	0.18	0.24
SVSLR	>0.32	0.20	0.27
S COD LR	>0.5	0.31	0.36
COD FOG/Total	>0.30	0	0
VS Reduction		56%	56%
TS Leaving	>3.4%	2.5%	3.1%

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4

Max Month – One Mesophilic Digester w/THP On-site Generated Loads plus TWAS

TS Received (ppd)		Nelson Current Sludge +TWAS	Nelson w/BNR +TWAS
Nelson		19500	44200
TWAS		26000	26000
FOG		0	0
Pass/Fail Criteria		**Scenario C**	**Scenario G3**
HRT/SRT	<12 Days	15.1	12.0
VSLR	>0.3	0.18	0.24
SVSLR	>0.16	0.15	0.19
S COD LR	>0.25	0.17	0.18
COD FOG/Total	>0.30	0	0
VS Reduction		56%	56%
TS Leaving	>6-7%	3.3%	4.4%

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5

Max Month – One Mesophilic Digester w/PAD On-site Generated Loads Plus TWAS

TS Received (ppd)		Nelson Current Sludge +TWAS	Nelson w/BNR +TWAS
Nelson		19500	44200
TWAS		26000	26000
FOG		0	0
Fail Criteria		**Scenario C**	**Scenario G3**
HRT/SRT	<13/7 Days	11.7/12.2	7.9/8.3
VSLR	>0.15	0.18	0.24
SVSLR	>0.16	0.16	0.26
S COD LR	>0.25	0.25	0.37
COD FOG/Total	>0.30	0	0
VS Reduction		51%	51%
TS Leaving	>3.2%	2.7%	3.1%

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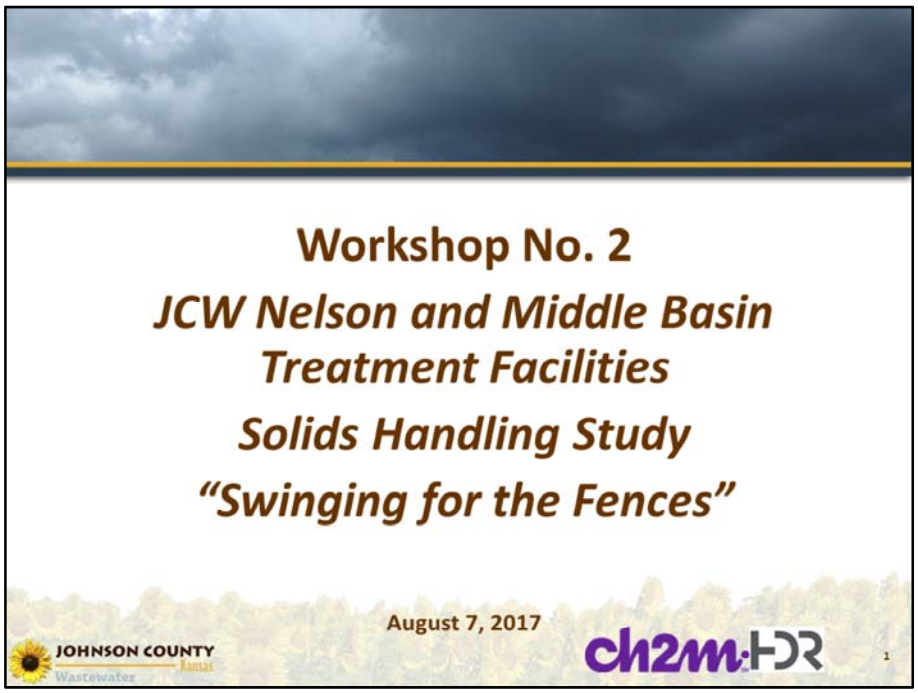
6



Meeting Minutes are provided here in NOTES

Moosesolids!

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2

Agenda

- Introductions
- Safety Moment
- Meeting Goals
- Review Projections and Economic and Non-monetary Basis of Analysis From Workshop No. 1
- Review Retained Alternatives From Workshop No. 1
- Review Results of Analyses of Retained Alternatives
- Attain Consensus on Selected Technology Alternatives
- Closing/Next Steps

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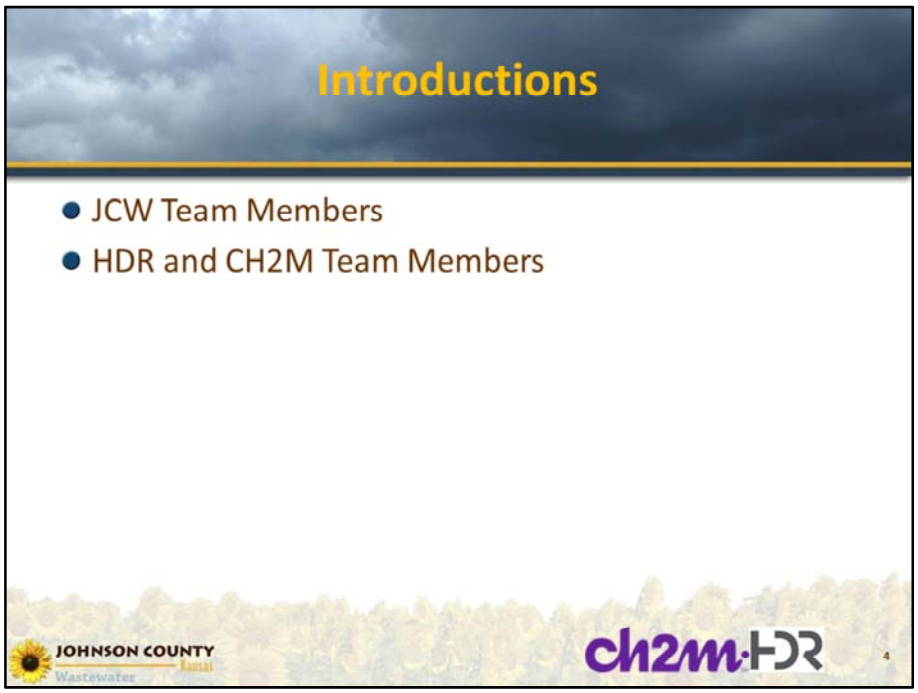
3



Attendees included:

Phil Webster, JCW	John Metzler, CH2M
Kenny Kellison, JCW	Dale Gabel, CH2M
Alex Szerwinski, JCW	Dave Parry, CH2M
Terry McQuerry, JCW	Estell Johnson, CH2M
Robert Morris, JCW	Brooke Conrardy, CH2M
Doug Nolkemper, JCW	Mike Kalis, HDR

Safety Moment
Food Safety Grilling Tips

- Clean surfaces and hands before preparing or handling food.
- Raw meats and poultry should be prepared separately from veggies and cooked foods. Do not put cooked meat on the same platter as raw meat.
- Do not let perishable foods sit out for more than two hours.
- Use a food thermometer to make sure food has reached a safe internal temperature.
  - *Steaks, roasts, chops:* *145°F*
  - *Poultry:* *165°F*
  - *Hamburgers:* *160°F*
  - *Fish:* *145°F*

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5

Meeting Goals

- Review Projections, Analysis Criteria
  - *Solids Projections*
  - *Economic Basis of Analysis*
  - *Non-Monetary Screening*
- Review Retained Alternatives From Workshop No. 1 :
  - *Digestion*
  - *Gas Usage*
  - *Biosolids Usage*
  - *TWAS Receiving*
  - *FOG Receiving*
- Review Results of Analyses of Retained Alternatives:
  - *Sizing and Performance*
  - *Conceptual Layout*
  - *Capital, operating and life-cycle costs*

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6

Solids Projections

- Projections
  - *FOG-Current and 2030, JC and Metro*
  - *BRM1 & NCAC WWTF TWAS-Current and 2030 (based on current rated capacities)*
  - *Nelson WWTF-Current and BNR*
  - *"The Bottom Line"*

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7

The "Bottom Line"

TS Received (ppd)	Nelson Current Sludge+All TWAS	Nelson Current Sludge+All TWAS & FOG *	Nelson w/BNR Facility+All TWAS	Nelson w/BNR Facility+All TWAS & FOG *
Nelson, AA	15,000	15,000	34,000	34,000
TWAS, AA	20,000	20,000	20,000	20,000
FOG, AA	--	9,200	--	10,400
Total AA	**35,000**	**44,200**	**54,000**	**64,400**
Nelson, MM	19,500	19,500	44,200	44,200
TWAS, MM	26,000	26,000	26,000	26,000
FOG, MM	--	12,000	--	13,600
Total MM	**45,500**	**57,500**	**70,200**	**83,800**

* Limitation is to not exceed maximum of 30% FOG feed COD/Total feed COD

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8

Annual average loadings used for annual O&M cost analysis. Max month loadings used for process sizing.

Acceptable Max FOG at Nelson as compared to Total Metro Area FOG

TS Received (ppd)	Nelson Current Sludge+All TWAS & FOG *	Nelson w/BNR Facility+All TWAS & FOG *
Annual Average, Max Allowable FOG	**9,200 ppd** (33% of total Metro Area) (16,000 gpd @ 7% solids)**	**10,400 ppd** (38% of total Metro Area) (18,000 gpd @ 7% solids)**
Max Month, Max Allowable FOG	**12,000 ppd** (36% of total Metro Area) (21,000 gpd @ 7% solids)**	**13,600 ppd** (41% of total Metro Area) (23,000 gpd @ 7% solids)**

* Limitation is to not exceed maximum of 30% FOG feed COD/Total feed COD

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9

Observations on "Bottom Line" Projections

- Nelson digesters cannot accept all Metro FOG
- Nelson digester can, however, accept some FOG:
  - *FOG receiving back up for Middle Basin*
  - *Facility for receiving additional Metro Area FOG*
- AA Solids ppd loading Increases:
  - *From present Nelson plus current TWAS to Nelson BNR, future TWAS, and Max FOG, 2.2X increase*

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10

Non-monetary screening criteria

Criterion	Description
Flexibility/Performance Risk	How well is the alternative able to successfully deal with fluctuations of flow and load; e.g., number of "tools" available to respond to changing conditions? Is it resistant to upset conditions? How extensive are the ramifications if all or part of the process fails? Does the alternative reduce chemical handling risks? Has pathogen or fecal coliform reactivation or regrowth been associated with the alternative/process?
Adaptability/Phasing	How easily can the upgrade be phased to meet JCW's needs over time in a cost-effective manner? How easily can the alternative/process be upgraded in the future to reliably produce a Class A Biosolids?
Proven Experience/ Domestic Support	How well proven is the technology in the application required for this project? Is the equipment and technology supported in the U.S.?
Staffing/Multiple Processes	Does the alternative require additional staffing? How well does the alternative match with existing operational staff in terms of capabilities, procedures, required certifications, and experience? Does the alternative incorporate additional unit processes or additional chemical systems that increase risk?

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11

It was noted that while not specifically stated, the "Flexibility/Performance Risk" criterion pertains to redundancy and reliability.

Non-monetary screening criteria, cont.

Criterion	Description
Sidestream Impacts	Does the alternative produce a sidestream that requires additional treatment prior to the liquids treatment train? How extensive or complex are the sidestream treatment requirements?
Land/Building Requirements	How well does the alternative fit on the existing site or within existing buildings? Does the alternative interfere with space that may be required for other future improvements?
Social Impacts	How well does the alternative prevent off-site impacts for traffic, noise, odors, visual, etc. How well does the alternative minimize sludge handling efforts? Higher degree of stabilization is an environmental benefit.

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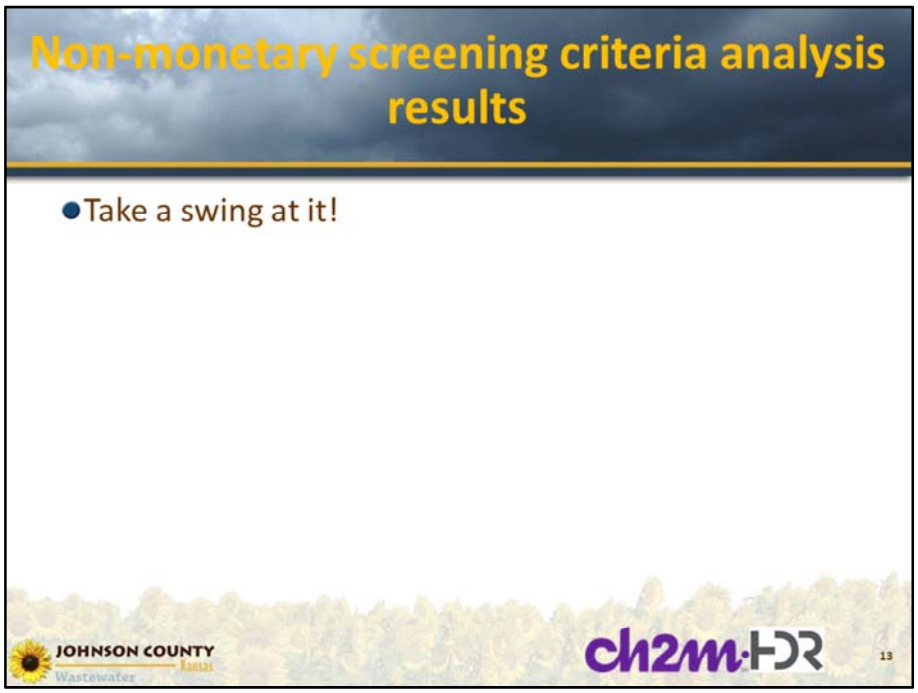
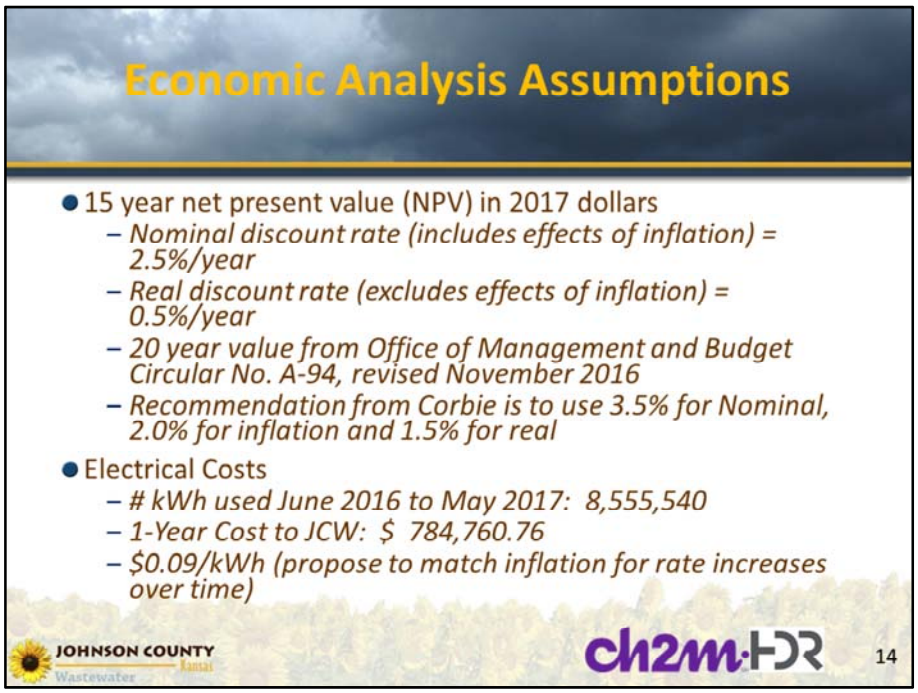
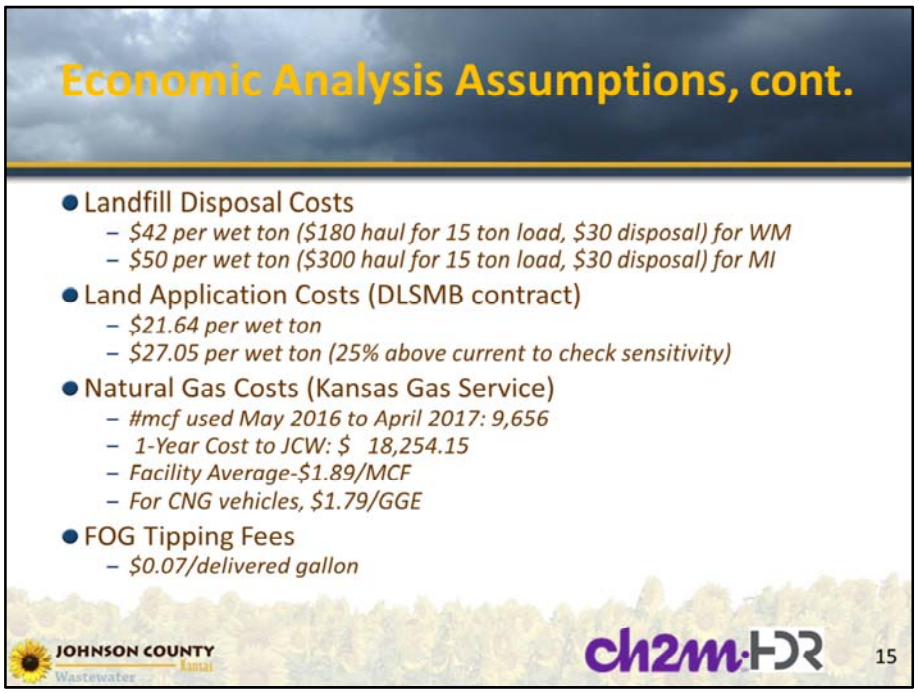
12



Non-monetary screening criteria were scored by JCW and are attached to these minutes as Attachment 1. The top priority for JCW on this project is social impacts while the lowest priorities were sidestream impacts and staffing.



JCW cautioned to remember that UV disinfection was likely both on-line and off-line during that period, which may have a significant impact on power demands. However, no changes to power cost/kWh were proposed.



Valuation of CNG is based on KGS website, one week prior to workshop. If pipeline quality gas produced cannot be wheeled directly for county usage elsewhere, or brokered to another CNG point of use, its value as renewable natural gas would likely be lower.

Economic Analysis Assumptions, cont.

- Labor Costs
  - *$33.31/hr including benefits (from Corbie)*
- Chemical Costs
  - *Ferric Chloride, $0.096/lb, or $1.12/gal.*
  - *Polymer, dry - $1.50/lb*
- Cost Estimate Markups and Contingency
  - *Contractor Markups – 20%*
  - *Contingency – 30%*
  - *Engineering, Legal, Admin – 25%*

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16

Review Retained Alternatives From Workshop No. 1

- BRM1 and NCAC TWAS receiving
- FOG waste receiving
- Anaerobic digestion
- Biogas utilization
- Biosolids use

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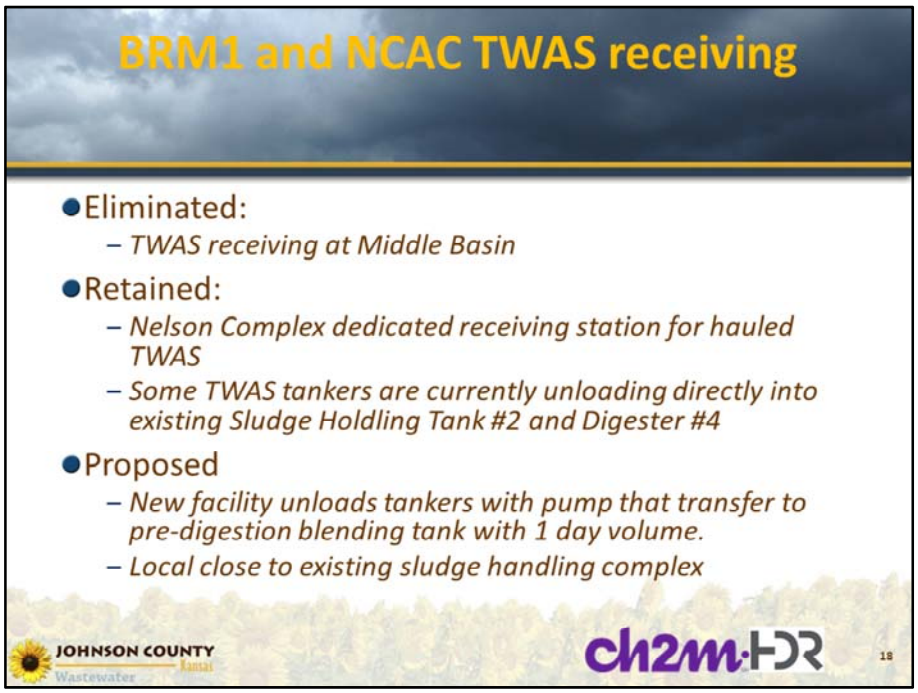
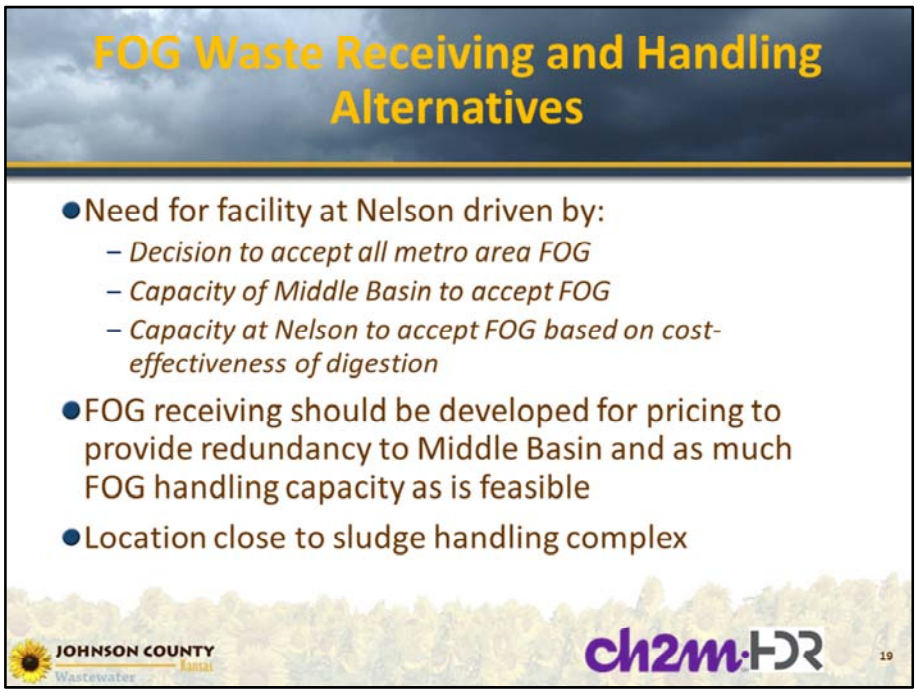
17



Old sludge holding tank off SE corner of Sludge Control Building was discussed as another potential TWAS unloading location. The tank is not currently covered and condition/location of piping between tank and sludge control building is not known, but could allow for gravity unloading of TWAS tankers and then pumped transfer to blend tanks. To eliminate another odor source, direct pump from TWAS trucks to blend tanks was proposed.

Alternate locations for FOG and/or TWAS receiving will be evaluated during the implementation plan but finalized during design.



Inquiries were made by JCW about possibly moving the proposed FOG receiving station outside of the Nelson gate. Best practice approach would suggest a digested sludge piping loop to serve as a carrier for the FOG up to the digesters.

Another potential location discussed was the current household hazardous waste facility.

Regardless of location, JCW would like to have 2-3 unloading stations to be able to unload multiple trucks at a time and make traffic flow easier to manage.

Cost estimate for FOG/TWAS Receiving facility is based on a footprint from similar sized facilities at other wastewater treatment plants. Alternate locations will be evaluated during the implementation plan but finalized during design.

Anaerobic Digestion Alternatives

- Eliminated:
  - *High solids meso, not feasible*
  - *THP, JCW will review in future*
  - *Thermo due to concerns that temperature range requirements may be too difficult to achieve*
- Retained:
  - *Short Term: Base Meso conversion of 2 existing digesters.*
  - *Long Term:*
    - Base 2 meso digesters + 1 additional digester
    - Base 2 meso digesters + PAD and/or Acid-Gas

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20

Anaerobic Digestion Alternatives Capacity and Performance Analysis

- Redundancy Criteria
  - *One digester out of service – meet max month loadings of, at a minimum, on-site generated solids and TWAS only*
  - *If TWAS cannot be accepted at Nelson, assume it can be diverted to Middle Basin and/or Tomahawk in emergency*
  - *All digesters in service – meet peak 2-week loadings with FOG receiving*
- Pass/Fail Criteria
  - *HRT/SRT, VSLR, Specific VSLR and COD LR (process driven)*
  - *Feed COD % FOG (Max 30% FOG COD/Total COD)*

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21

Anaerobic Digestion Alternatives Capacity and Performance Analysis Failure Criteria

	Mesophilic Digestion	Acid-Gas Digestion	Acid-Gas Digestion with PAD
Solids Retention Time	<15 Days	<1.5 Days Acid phase <12 Days Mesophilic	<1.5 Days Acid phase <11.5 Days Mesophilic < 7 days PAD
Volatile Solids Loading Rate	>0.15	>0.15	>0.15
Specific Volatile Solids Loading Rate	>0.16	>0.16	>0.16
Specific COD Loading Rate	>0.25	>0.25	>0.25
COD Feed (FOG/Total COD)	>0.30	>0.30	>0.30
TS Leaving (%)	>3.2	>3.2	>3.2

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22

Digestion Upsteam/Downstream Sizing Criteria (max month)

	Pre-Digestion Blending/Storage	Post Digestion Storage
Max Month Flows Undigested Nelson Current + TWAS Nelson BNR + TWAS	 140,000 gpd 190,000 gpd	
Max Month Flows Digested Nelson Current + TWAS+FOG Nelson BNR + TWAS+FOG		 160,000 gpd 210,000 gpd
Desired Hydraulic Retention Time	1 Day	3 days
Desired Volume Current Need Future BNR Need	 140,000 gallons 190,000 gallons	 480,000 gallons 630,000 gallons

- Existing Sludge Holding Tanks (66,500 gal ea, 133,000 gal total)
- Existing Digesters 1 and 2 (285,000 gal ea, 571,000 gal total)

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23

Digestion Alternatives-Capacity Analysis
2 Meso plus 1 additional Meso

Scenario Monthly Max Key: 1+1 = 1 Duty, 1 Standby	Current +TWAS	Current +TWAS +FOG	BNR +TWAS	BNR +TWAS +FOG
1 + 1 Meso Digesters = 2 Meso Total	FAIL SRT, VSLR, SVSLR, SCODLR			
2 + 1 Meso Digesters = 3 Meso Total	PASS	PASS 36% of FOG accepted	PASS	FAIL SRT, SCODLR, TS% Leaving
3 + 0 Meso Digesters = 3 Meso Total	PASS	PASS	PASS	PASS 41% of FOG accepted

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24

Anaerobic Digestion Alternatives
Base 2 Meso plus 1 additional Meso

- Convert existing large (80' dia) digesters 3 and 4 to mesophilic pancake-type anaerobic digesters
- Add 3rd 80' dia mesophilic digester to meet firm capacity/redundancy criteria
- Assumes new building to house new ancillary equipment, for conservatism. Tanks in good shape, requiring new lids, gas systems and piping
- Convert existing sludge holding tanks to pre-digestion blending tanks. Requires new mixing system.
- Convert existing Digesters 1 and 2 to post-digestion storage, with mixing systems and floating covers.
- Provide enclosed flares

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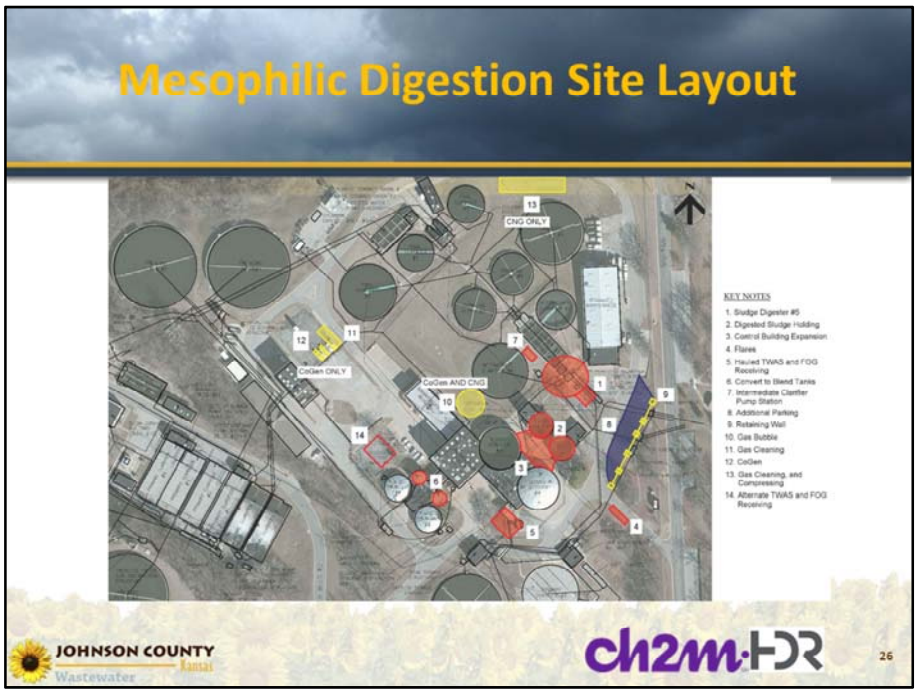
25



Hard copies of site layouts (11”x17”) were distributed at meeting and are attached (Attachment 2)

It was discussed that odor control could be moved to another location to make more space available in the existing sludge control building (rather than building an additional control building.) Budget is based on new building for conservatism.

It was offered that another possible location for Digester 5 in this layout could be in the paved area south of the existing sludge control building.

There was concern about abandoning intermediate clarifiers 1 and 2 due to reliability issues with intermediate clarifiers 3 and 4. Hard copies of calculated impacts on clarifier loadings were distributed at meeting and are attached (Attachment 3)

Digestion Alternatives-Capacity Analysis
Mesophilic plus acid phase digesters

Scenario Monthly Max Key: 1+1 = 1 Duty, 1 Standby	Current +TWAS	Current +TWAS +FOG	BNR +TWAS	BNR +TWAS +FOG
1 + 1 Acid Phase and 1 + 1 Meso Digesters = 4 Digesters Total	FAIL SRT, SVSLR, SCODLR			
2 + 1 Acid Phase and 2 + 1 Meso Digesters = 6 Digesters Total	PASS	PASS 36% of FOG accepted	PASS	PASS 41% of FOG accepted

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27

Anaerobic Digestion Alternatives
Base 2 Meso plus Acid Phase digesters

- Convert existing large (80' dia) digesters 3 and 4 to mesophilic pancake-type anaerobic digesters
- Convert existing smaller digesters 1 and 2 to acid phase digesters. Decanting off Acid Phase digesters offers potential VFAs to future BNR liquid treatment stream.
- Does not meet redundancy or loading criteria, and adding a 3rd pair of acid-gas digesters is still required
- Eliminates the opportunity to utilize Digesters 1 and 2 for post-digestion storage.
- Convert existing sludge holding tanks to pre-digestion blending tanks. Requires new mixing system.
- Construct new tanks in new location for post-digestion storage, with mixing systems and floating covers.

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28

Acid-Gas Digestion Site Layout

KEY NOTES

1. Sludge Digester #6
2. Acid-Phase Digesters
3. Digested Sludge Holding
4. Flares
5. Hauled TWAS and FOG Receiving
6. Convert to Blend Tanks
7. Intermediate Clarifier Pump Station
8. Additional Parking
9. Retaining Wall
10. Gas Bubble
11. Gas Cleaning
12. CoGen
13. Gas Cleaning, and Compressing
14. Alternate TWAS and FOG Receiving

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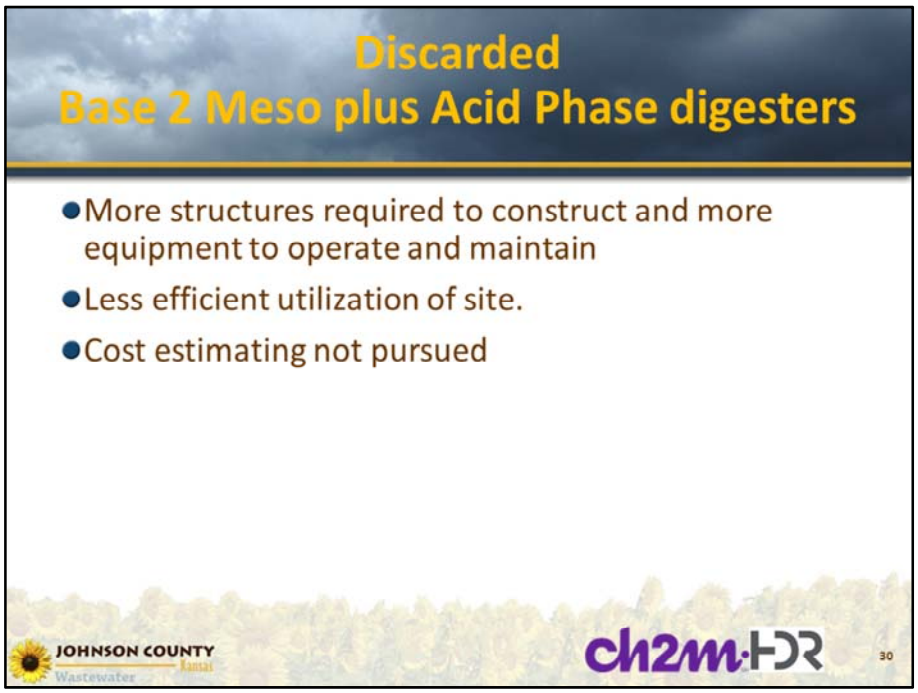
29



CH2M proposed eliminating the Acid-Gas alternatives. JCW agreed.

Anaerobic Digestion Alternatives
Base 2 Meso plus 1 Meso and 1 PAD/storage or Meso/Storage

- Convert existing large (80' dia) Digesters 3 and 4 to mesophilic pancake-type anaerobic digesters
- Demo complete footprint of digesters 1 and 2
- Add 3rd 80' dia mesophilic digester to meet firm capacity/redundancy criteria
- Construct 4th 80' dia digester for both mixed holding and secondary digestion (either mesophilic or PAD).
  - *When operated as meso, offers redundancy when also accepting FOG. Operates similar to DLSMB.*
  - *When operated as PAD, offers treatment advantages for future BNR*
- Convert existing sludge holding tanks to pre-digestion blending tanks. Requires new mixing system.

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31

3-Meso + 4th Tank in Consolidated Footprint

KEY NOTES

1. New Digester #1 & #2 #5 & Building
2. Control Building Expansion
3. Flares
4. Hauled TWAS and FOG Receiving
5. Convert to Blend Tanks
6. Alternate TWAS and FOG Receiving

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32

Digestion Alternatives
PAD/Storage Capacity Analysis

- Volume of one 80' digester is 1,450,000 gal
- Desired minimum capacity for PAD/holding tank is:
  - *3 days MM holding: 480,000 - 630,000 gal*
  - *7 days MM SRT in PAD: 1,120,000 – 1,470,000 gal*
  - *10 days MM: 1,600,000 (Current) - 2,100,000 (BNR) gal*
- If the 3 day storage volume is pulled down to start a long holiday weekend, PAD SRT/HRT would be reduced to 4 days, which would be expected to:
  - *result in some reduction in nitrification and centrate having more ammonia returned to the headworks. Short term occurrence.*
  - *Only minor reduction in PAD VSR*

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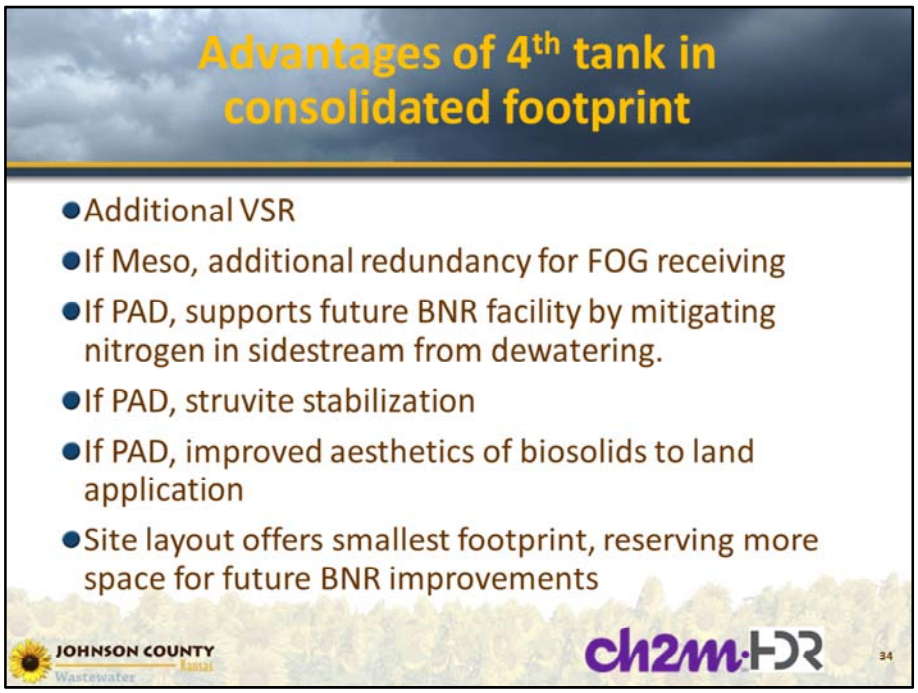
33



Site layout with consolidated footprint was preferred.

Total Project Capital Costs for Digestion

	2+1 Mesophilic Digesters (3 total arrangement)	3+1 Mesophilic or PAD (4 total arrangement)
Rehabilitate Dig 3&4 to perform meso digestion	$ 9,150,000	$ 9,150,000
Build one additional 1.45MG meso digester (Dig 5)	$ 12,234,000	$ 12,234,000
Sludge Holding/Blending: Undigested	$ 717,000	$ 717,000
Digested Sludge Holding:		
Rehabilitate Dig 1&2	$ 2,111,000	
Construct 4th 1.45 MG Digester		$ 12,234,000
Demolition and other site mitigation costs	$ 1,882,000	$ 589,000
FOG Receiving/TWAS Unloading	$ 3,750,000	$ 3,750,000
Total Capital Cost:	$ 29,844,000	$ 38,674,000

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35

JCW expressed a desire to have a plan for phasing in the capital projects. JCW would like to consider immediate rehabilitation of Digesters 3&4 to mesophilic digesters and possibly a FOG/TWAS unloading station with future plans to implement further improvements. This will be evaluated during the implementation plan but finalized during design.

Biogas Utilization Alternatives

- Eliminated:
  - *Onsite CNG, due to insufficient demand on-site*
  - *RINs, consistent with Tomahawk evaluation*
  - *Fueling sludge drying, due to absence of drivers for Class A*
- Retained:
  - *Wheeling to offsite CNG*
  - *Cogeneration due to cost-effectiveness at Tomahawk*

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36

Biogas Production "Bottom Line"

	Nelson Current Sludge+All TWAS	Nelson Current Sludge+All TWAS & Max FOG	Nelson w/BNR Facility+All TWAS	Nelson w/BNR Facility+All TWAS & Max FOG
Total AA				
Gas Prod, scf/d	183,000	307,000	258,000	398,000
Gas Prod, BTU/hr	4,423,000	7,419,000	6,235,000	9,618,000
Total MM *				
Gas Prod, scf/d scfm	238,000 165	387,000 269	336,000 233	504,000 350

* MM used for sizing gas handling equipment capacities, 200 scfm parallel trains are assumed (400 scfm total from 2 trains to cover worst case condition)

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37

Biogas Utilization Alternatives
Wheeling to Off-Site CNG

- Cleaning (H_2S, moisture & Siloxane Removal) of all gas generated.
- Gas use must first meet needs for heating digesters (boilers for heat exchangers).
- Excess after digester heating needs can be concentrated (CO2 removal) and compressed for delivery to Kansas Gas Service for wheeling to off-site CNG station
- Includes dual membrane gas bubble (52'dia, 53,000 cu.ft. capacity) for storage (approx. 2.5 hours at 350 scfm). Could consider 2 smaller, parallel units.

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38

Excess Gas for Wheeling (after cleaning)

	Nelson w/BNR Facility+All TWAS	Nelson w/BNR Facility+All TWAS & Max FOG
Total AA		
Gas Prod, MMBTU/d	150	231
MMBTU/d digesters	-73	-87
MMBTU/d loss	-11	-19
Excess MMBTU/day * Excess GGE/month	66 16,000	125 30,000
Total MM **		
scf/day	110,000	187,000

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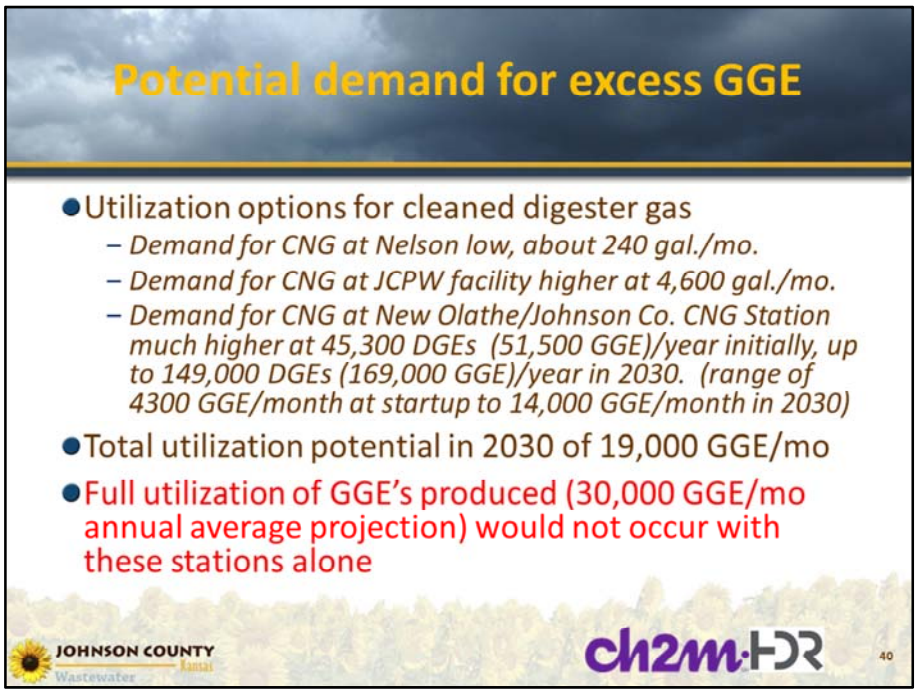
39



If the demand does not exist at the CNG stations, it will be necessary to broker a buyer for the remaining gas.

JCW expressed concerns that gas production at Middle Basin has varied greatly, even when the volume of FOG delivered remains fairly constant. It was noted that the variability could have multiple drivers, from FOG concentration/strength variability to digester temperature variability.

Biogas Utilization Alternatives
Cogeneration

- Assumes all gas cleaned (H2S, moisture and Siloxane Removal) will be sent to cogen and heat recovered from generators will used for digester heating (CHP).
- Assumes dual membrane gas bubble (52'dia, 53,000 cu.ft. capacity) for storage (approx. 2.5 hours at 350 scfm). Again, could consider 2 smaller, parallel units.

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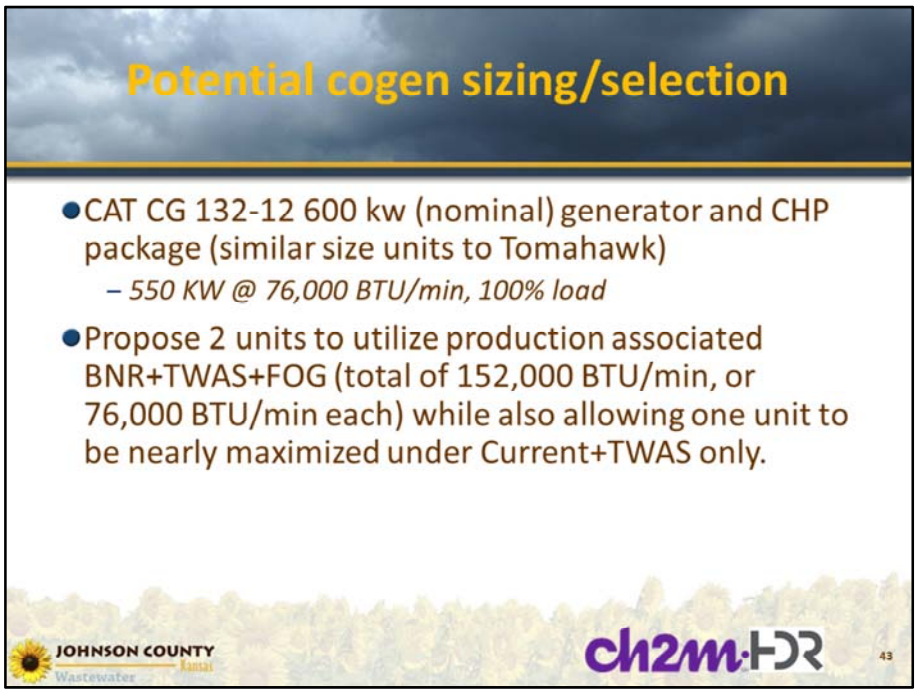
41

Cogen Potential

	Nelson Current Sludge+All TWAS	Nelson Current Sludge+All TWAS & Max FOG	Nelson w/BNR Facility+All TWAS	Nelson w/BNR Facility+All TWAS & Max FOG
Total AA				
Gas Prod, MMBTU/d	106	178	150	231
MMBTU/d loss	-5	-9	-8	-12
Cogen MMBTU/day	101	169	142	219
Cogen BTU/min	70,000	117,000	99,000	152,000
Electricity Generated KW	500 (1 engine)	800 (2 engines)	650 (2 engines)	1100 (2 engines)
Waste Heat Produced BTU/hr	1,800,000	3,200,000	2,800,000	3,900,000

JOHNSON COUNTY Kansas Wastewater ch2m HDR 42

JCW would prefer to phase in additional engines as the capacity of smaller units is reached.



JCW asked if there are engines that run without cleaning equipment. Response from CH2M:

- Some older model engines run without cleaning, but newer engines typically run on clean gas.
- The reasons for running on clean gas:
  - More predictable maintenance
  - Emissions requirements

JCW staff is concerned about the O&M demands that accompany gas cleaning.

Total Project Capital Costs for Gas Utilization

	Wheeling to Off-Site CNG	Cogen/CHP
Gas Storage	$ 1,348,000	$ 1,348,000
Gas Cleaning (H2S, Siloxane, Moisture)	$ 2,759,000	$ 2,759,000
Cogen/CHP		$ 7,156,000
CO2 removal and injection to KGS	$ 7,100,000	
Total Project Capital Cost:	**$ 11,207,000**	**$ 11,263,000**

JOHNSON COUNTY Kansas Wastewater

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44

It is not clear how KGS will respond to wheeling as they do not have other clients that wheel to the pipeline at this time. Should this alternative be selected for implementation, additional discussion with KGS will be required.

Life Cycle Costs for CNG vs. Cogen/CHP

CNG	Capital Cost	Annual Cost	15 yr NPV
Gas Storage & Cleaning	$ 4,107,000	$100,000	
CO2 Removal and Injection	$ 7,100,000	$ 150,000	
Avoided/Sold Natural Gas (@$1.79)	0	($ 644,000)	
RIN (@$0.60)	0	($ 216,000)	
Total Cost:	**$ 11,207,000**	**($ 610,000)**	**$3,062,000**
Cogen/CHP	**Capital Cost**	**Annual Cost**	**15 yr NPV**
Gas Storage & Cleaning	$ 4,107,000	$100,000	
Cogen/CHP	$ 7,156,000	$ 250,000	
Avoided Power	0	($ 780,000)	
Total Cost:	**$ 11,263,000**	**($ 430,000)**	**$5,519,000**

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45

Without RINs, the annual costs and NPVs become nearly identical. And if the natural gas cannot be brokered or wheeled as GGE, its market value could be even lower, favoring the Cogen alternative. The Cogen alternative has less unknowns/risks associated with its implementation.

Biosolids Use Alternatives

- Eliminated:
  - *Class A (non-restricted use)due to cost and lack of drivers*
  - *"Oil from Sludge" Pyrolysis due to cost and relatively new technology*
  - *Gasification (ex. Element Carbon) due to cost and relatively new technology*
- Retained:
  - *Landfill*
  - *Agricultural Land Application of Class B*

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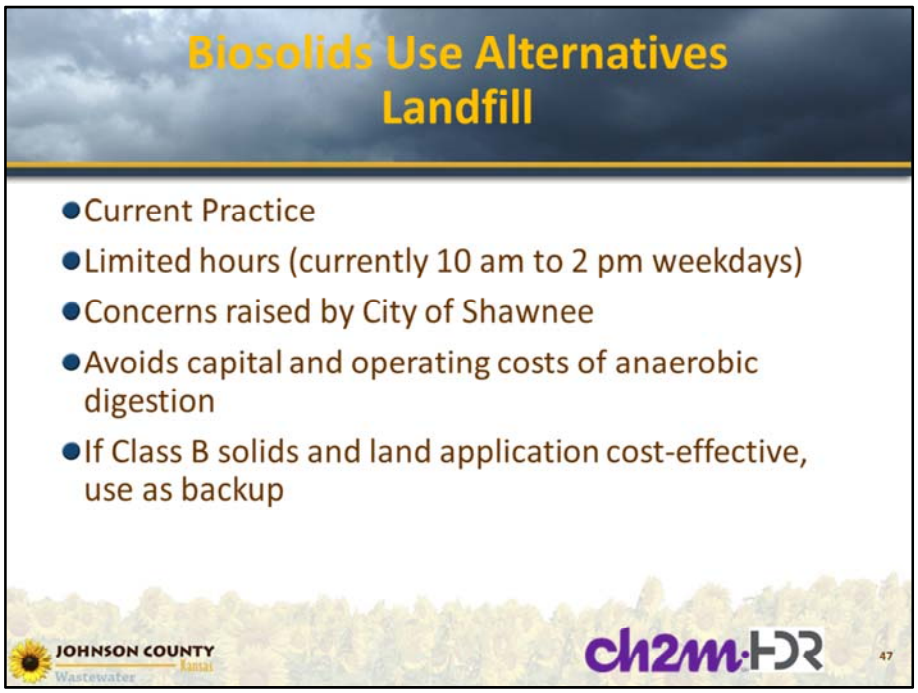
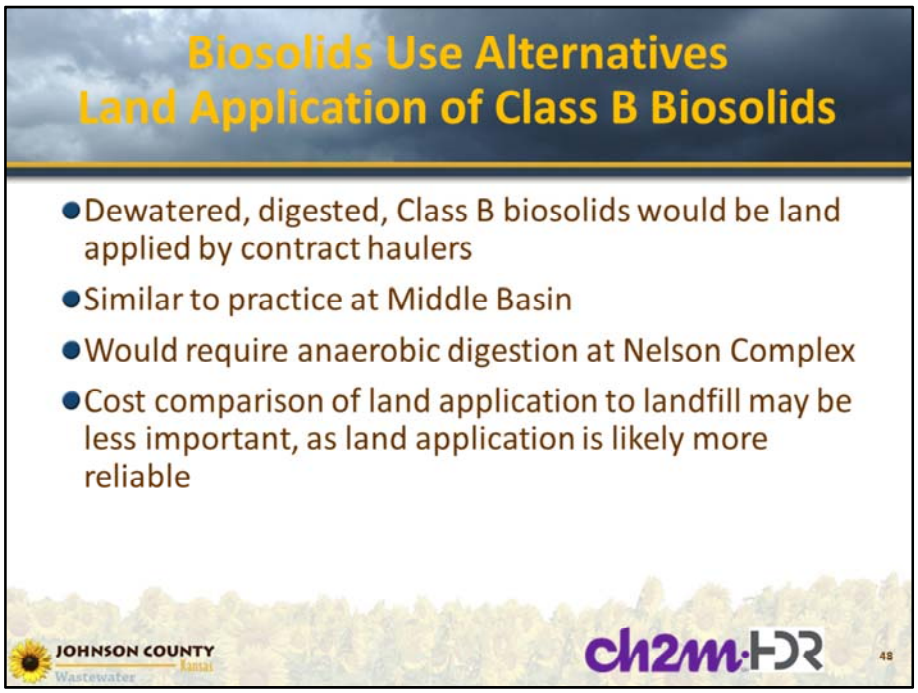
46



Hours for hauling to the landfill have been recently changed to also include Midnight to 4AM. Daytime hauling hours are 10 am – 3 pm weekdays (correction from 2 pm in slide above).
City of Shawnee special use permit (SUP) may be re-opened at any time, and carries the risk of it being changed to not allow sludge to be accepted at the landfill (or specifically not allow un-digested sludge).
CH2M will investigate if short term options (other landfills) are available if the landfill refuses sludge.



Current and past contract haulers all seem to have access to more than enough land for land application.

Biosolids Production "Bottom Line"

	Nelson Current Sludge+All TWAS	Nelson Current Sludge+All TWAS & Max FOG	Nelson w/BNR Facility+All TWAS	Nelson w/BNR Facility+All TWAS & Max FOG
Total AA				
Undigested ppd Wet tons/day	35,000 62	44,200 78	54,000 96	64,400 114
Digested ppd Wet tons/day	23,000 48	24,000 50	37,000 77	38,000 79
Total MM				
Undigested ppd Wet tons/day	45,500 81	57,500 102	70,200 124	83,800 148
Digested ppd Wet tons/day	30,000 63	32,000 67	48,000 100	51,000 107

Assumptions: Centrifuge capture of 92%, cake solids of 26% undigested/25% digested

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49

Life Cycle Costs for Landfill vs. Digestion (2+1 Meso) and Land Application

Landfill	Capital Cost	Annual Cost	NPV
Land Application (Contract range of $42 - $50 per wet ton)		$1,465,000-$1,744,000	
FOG Tipping Fees (Revenue)		0	
Total Cost:	**$ 0**	**$1,465,000-$1,744,000**	**$19,548,000-$23,271,000**
Digestion and Land Application	**Capital Cost**	**Annual Cost**	**NPV**
Blending/Digestion/Holding	$ 26,094,000	$ 745,000	
FOG Receiving/TWAS Unloading	$ 3,750,000	$ 185,000	
Land Application (Contract range of $21.64- $27.05 per wet ton)		$628,000-$784,000	
FOG Tipping Fees (Revenue)		($618,000)	
Total Cost:	**$ 29,844,000**	**$ 940,000-$ 1,096,000**	**$42,386,000-$44,468,000**

JOHNSON COUNTY Kansas Wastewater

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50

Dewatering Capacity Check
(Firm Capacity of 210,000 lbs/wk *)

	Nelson Current Sludge+All TWAS	Nelson Current Sludge+All TWAS & Max FOG	Nelson w/BNR Facility+All TWAS	Nelson w/BNR Facility+All TWAS & Max FOG
Total AA				
Undigested lbs/wk Req'd hrs/day**	245,000 8.2	309,000 10.3	378,000 12.6	451,000 15.0
Digested lbs/wk Req'd hrs/day**	161,000 5.4	168,000 5.6	259,000 8.6	266,000 8.9
Total MM				
Undigested ppd Req'd hrs/day**	319,000 10.6	403,000 13.4	491,000 16.4	589,000 19.6
Digested ppd Req'd hrs/day**	210,000 7.0	224,000 7.5	336,000 11.2	357,000 11.9

*Firm centrifuge capacity at 6,000 pph/ea, 7 hrs/day, 5 days/week
**Req'd hrs/day calculated at 6,000 pph, 5 days/week

JOHNSON COUNTY Kansas Wastewater ch2m HDR 51

All boxes where required hrs/day of centrifuge operation exceeds 7 hrs/day are highlighted.

Total Project Capital Cost Summary (with gas utilization)

	2+1 Mesophilic Digesters (3 total arrangement)	3+1 Mesophilic or PAD (4 total arrangement)
Rehabilitate Dig 3&4 to perform meso digestion	$ 9,150,000	$ 9,150,000
Build one additional 1.45MG meso digester (Dig 5)	$ 12,234,000	$ 12,234,000
Sludge Holding/Blending: Undigested	$ 717,000	$ 717,000
Digested Sludge Holding:		
Rehabilitate Dig 1&2	$ 2,111,000	
Construct 4th 1.45 MG Digester		$ 12,234,000
Demolition and other site mitigation costs	$ 1,882,000	$ 589,000
FOG Receiving/TWAS Unloading	$ 3,750,000	$ 3,750,000
Gas Utilization	$ 11,263,000	$ 11,263,000
Total Capital Cost:	**$ 41,107,000**	**$ 49,937,000**

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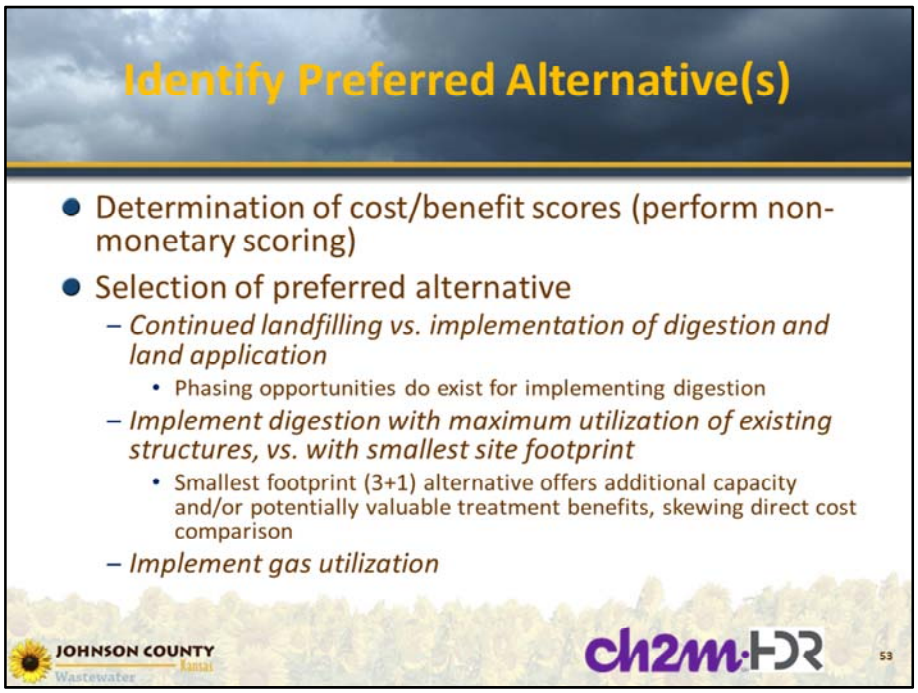
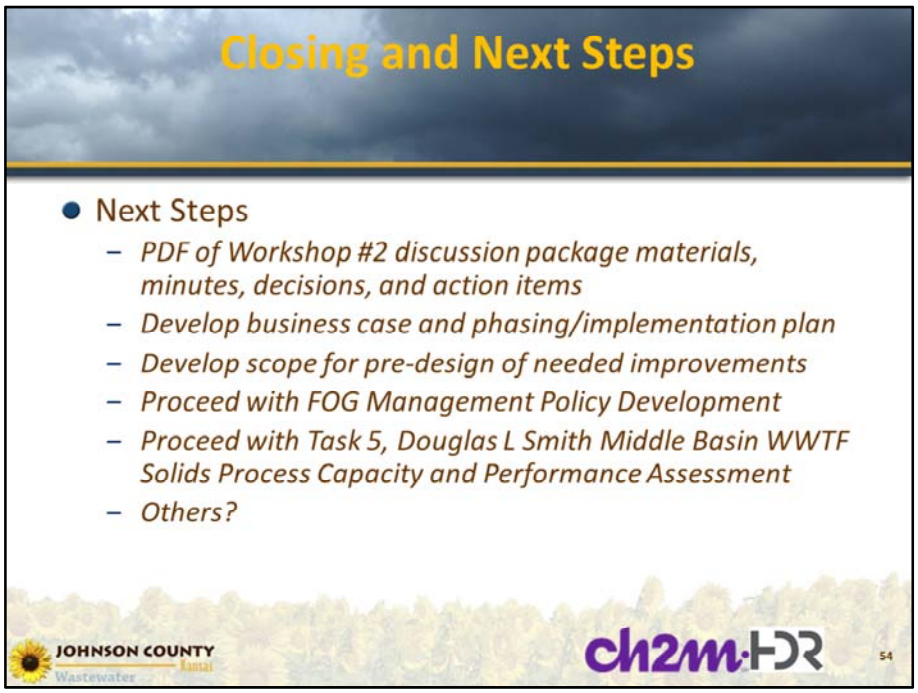
52



See Attachment 1 for cost/benefit scoring.

While the benefit score of land application cannot outweigh the impacts of the capital costs of implementing digestion, the risk of the landfill turning away undigested sludge must also be considered. A risk analysis would place the landfill, as the only disposal option, as both a high risk and a high probability of failure.



CH2M will prepare meeting minutes and an executive summary for Tami and Aaron.

CH2M will begin working on developing a business case and phasing/implementation plan to resume digestion at Nelson with minimal initial redundancy, but that will work toward the plan of 4 digesters in the consolidated site layout footprint. Receiving facilities for hauled TWAS and FOG would be preferred in the initial phase, but gas utilization (beyond heating digesters) would be delayed until a later phase.

CH2M will proceed to the Middle Basin assessment tasks and FOG management policy development.

It's a Home Run!

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55

Attachment 1:
Non-Monetary Screening

Maximum Score = 10

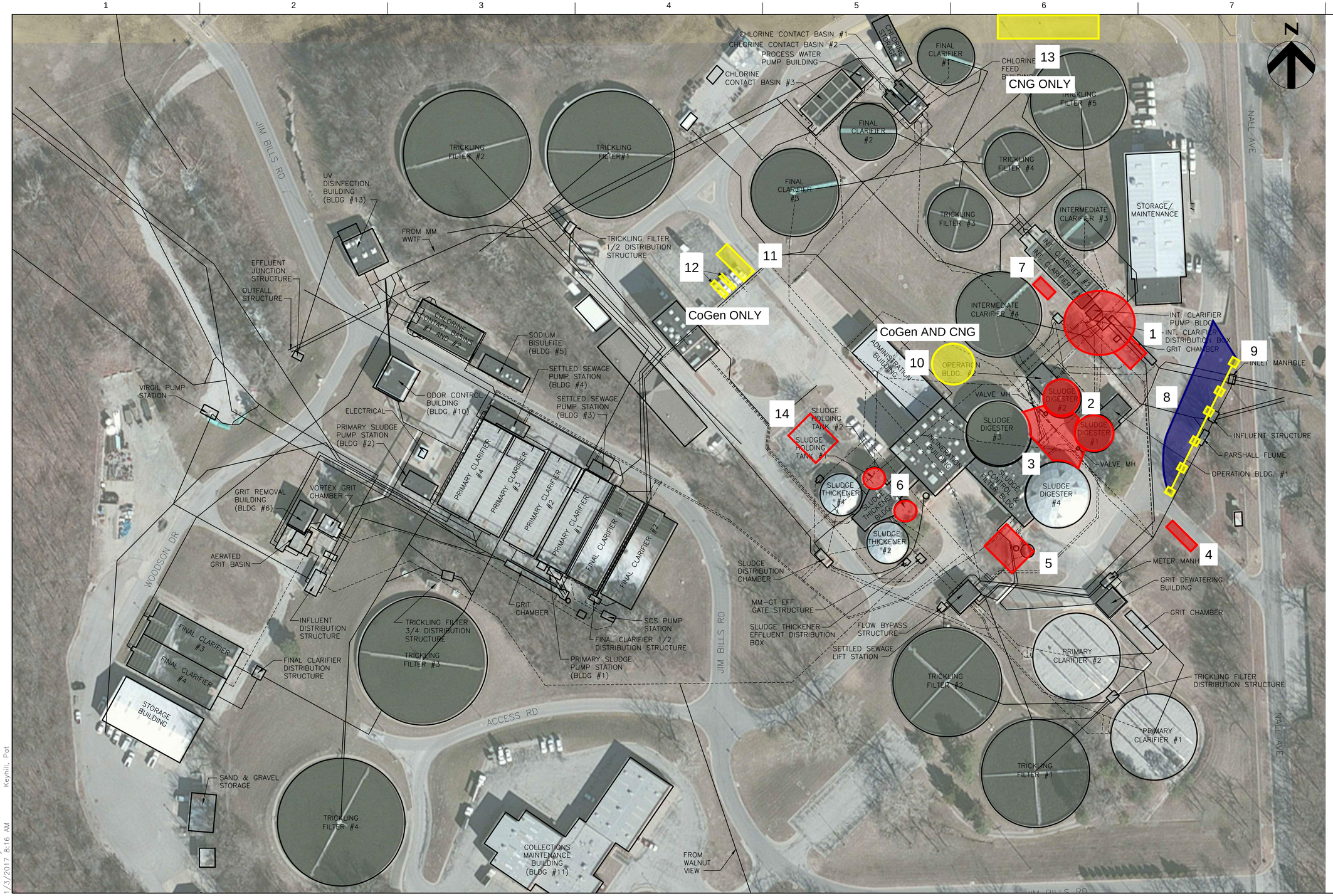
Minimum Score = 1

	Flexibility/ Performance Risk	Adaptability/ Phasing	Proven Experience/Domestic Support	Staffing/ Multiple Processes	Sidestream Impacts	Land/ Building Requirements	Social Impacts	Total Score	% of Total	Relative Weights
Flexibility/ Performance Risk	A	8	5	7	8	7	3	38	16.5%	1.90
Adaptability/ Phasing	3	B	4	7	7	4	3	28	12.1%	1.40
Proven Experience/Domestic Support	6	7	C	9	8	7	5	42	18.2%	2.10
Staffing/ Multiple Processes	4	4	2	D	6	3	2	21	9.1%	1.05
Sidestream Impacts	3	4	3	5	E	3	2	20	8.7%	1.00
Land/ Building Requirements	4	7	4	8	8	F	2	33	14.3%	1.65
Social Impacts	8	8	6	9	9	9	G	49	21.2%	2.45
								231	100%	
							minimum =	20		

	Flexibility/ Performance Risk	Adaptability/ Phasing	Proven Experience/Domestic Support	Staffing/ Multiple Processes	Sidestream Impacts	Land/ Building Requirements	Social Impacts	Total Score	Unweighted Rank
D1: Meso 2+1	1	4	5	6	4	3	4	27	2
D2: Meso 3+1	9	6	5	4	6	7	6	43	1
L1: Landfill	1	5	5	7	6	9	1	34	2
L2: Digestion and Land App	9	5	5	3	4	1	9	36	1

	Flexibility/ Performance Risk	Adaptability/ Phasing	Proven Experience/Domestic Support	Staffing/ Multiple Processes	Sidestream Impacts	Land/ Building Requirements	Social Impacts	Total Weighted Score	Weighted Rank	Capital Cost	Normalized NPV	Benefit/ Normalized NPV
Relative Weight=	1.90	1.40	2.10	1.05	1.00	1.65	2.45					
D1: Meso 2+1	1.9	5.6	10.5	6.3	4.0	5.0	9.8	43.05	2	$29,844,000	1	43.1
D2: Meso 3+1	17.1	8.4	10.5	4.2	6.0	11.6	14.7	72.45	1	$38,674,000	1.29587187	55.9
									Min NPV =	29,844,000		
										NPV		
L1: Landfill	1.9	7.0	10.5	7.4	6.0	14.9	2.5	50.05	2	$23,271,000	1	50.1
L2: Digestion and Land App	17.1	7.0	10.5	3.2	4.0	1.7	22.1	65.45	1	$44,468,000	1.9108762	34.3
									Min NPV =	23,271,000		

Attachment 2:
Suggested Site Layouts



KEY NOTES

1. Sludge Digester #5
2. Digested Sludge Holding
3. Control Building Expansion
4. Flares
5. Hauled TWAS and FOG Receiving
6. Convert to Blend Tanks
7. Intermediate Clarifier Pump Station
8. Additional Parking
9. Retaining Wall
10. Gas Bubble
11. Gas Cleaning
12. CoGen
13. Gas Cleaning, and Compressing
14. Alternate TWAS and FOG Receiving

10C101.dwg
1/3/2017 8:16 AM
Keyhill, Pat

ISSUE	DATE	DESCRIPTION
A	01-06-17	ISSUED FOR REVIEW

PROJECT MANAGER MICHAEL KALIS

PROJECT NUMBER 00000000XXXXXX

JOHNSON COUNTY KANSAS Wastewater

JOHNSON COUNTY WASTEWATER
NELSON COMPLEX WWTF
NELSON AND DLSMB SOLIDS HANDLING STUDY

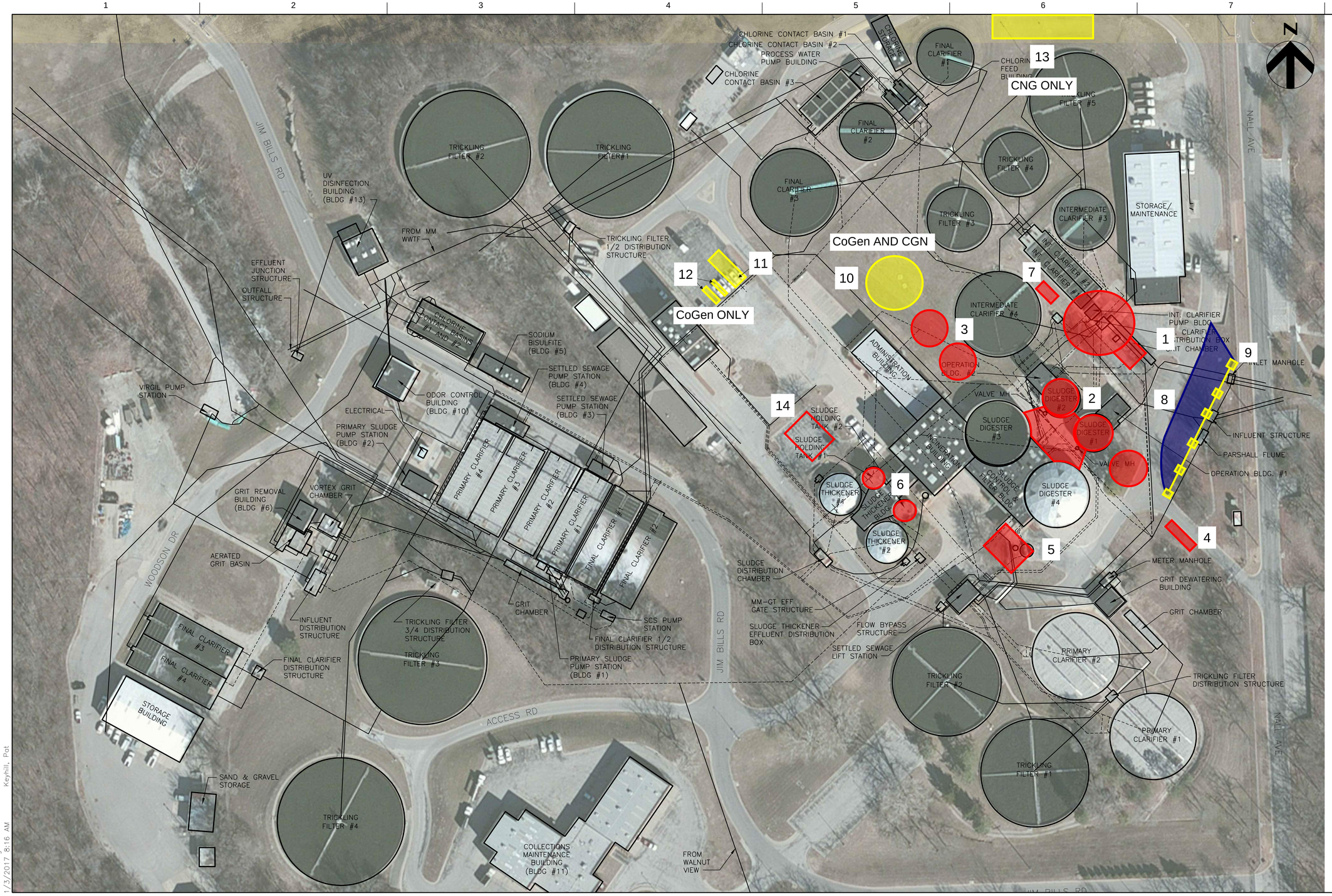
Mesophilic Digestion

0 1" 2"

FILENAME 10C101.dwg

SCALE 1" = 60'

SHEET Figure 1



KEY NOTES

1. Sludge Digester #6
2. Acid-Phase Digesters
3. Digested Sludge Holding
4. Flares
5. Hauled TWAS and FOG Receiving
6. Convert to Blend Tanks
7. Intermediate Clarifier Pump Station
8. Additional Parking
9. Retaining Wall
10. Gas Bubble
11. Gas Cleaning
12. CoGen
13. Gas Cleaning, and Compressing
14. Alternate TWAS and FOG Receiving

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ISSUE	DATE	DESCRIPTION
A	01-06-17	ISSUED FOR REVIEW

PROJECT MANAGER MICHAEL KALIS

PROJECT NUMBER 00000000XXXXXX

JOHNSON COUNTY KANSAS Wastewater

JOHNSON COUNTY WASTEWATER
NELSON COMPLEX WWTF
NELSON AND DLSMB SOLIDS HANDLING STUDY

Acid-Gas Digestion

0 1" 2"

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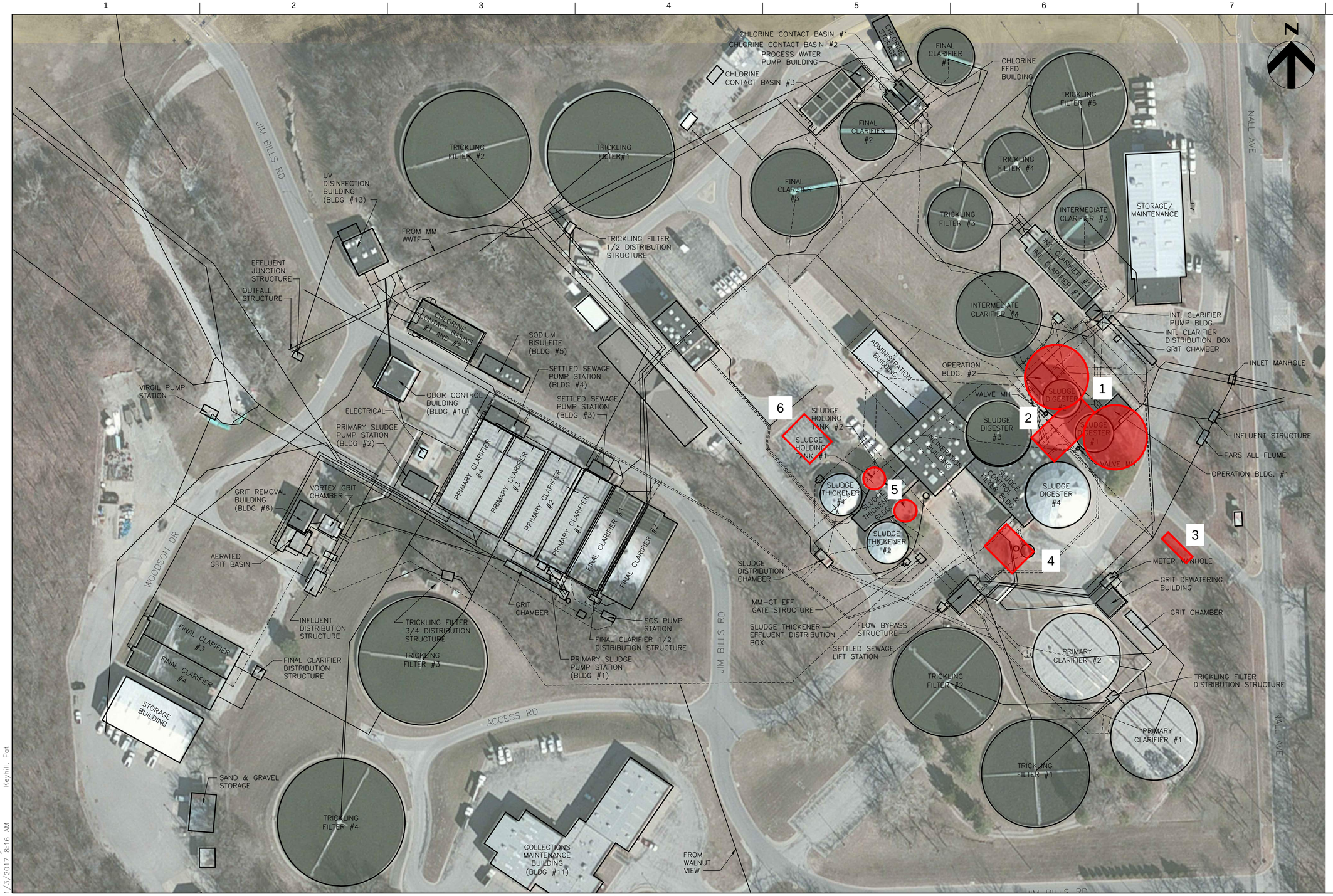
SCALE 1" = 60'

SHEET Figure 2



KEY NOTES

1. New Digester #1 & #2 #5 & Building
2. Control Building Expansion
3. Flares
4. Hauled TWAS and FOG Receiving
5. Convert to Blend Tanks
6. Alternate TWAS and FOG Receiving

10C101.dwg
1/3/2017 8:16 AM Keyhill, Pat

ISSUE	DATE	DESCRIPTION
A	01-06-17	ISSUED FOR REVIEW

PROJECT MANAGER MICHAEL KALIS

PROJECT NUMBER 00000000XXXXXX

JOHNSON COUNTY WASTEWATER
NELSON COMPLEX WWTF
NELSON AND DLSMB SOLIDS HANDLING STUDY

Mesophilic Digestion/PAD

0 1" 2"

FILENAME 10C101.dwg

SCALE 1" = 60'

SHEET Figure 3

Attachment 3:
Mission Main Clarifier Loading Calculations

Mission Main Clarifier Calculations

		Overflow Rates	
Reference	**Area (SF)**	**Average (GPD/SF)**	**Peak (GPD/SF)**
Metcalf and Eddy, 3rd Edition, Table 10-12		400-800	1000-1200
WEF MOP 11		720	1008
KDHE		1000	
AWWA/ASCE		800	1500
MOP 8		589-1473	1498-2995

Existing Intermediate Clarifiers			
Intermediate Clarifier 1	1,800	521	1633
Intermediate Clarifier 2	1,800	521	1633
Intermediate Clarifier 3	3,794	521	1633
Intermediate Clarifier 4	7,854	521	1633

Intermediate Clarifiers 3 & 4 Only			
Intermediate Clarifier 3	3,794	601	2136
Intermediate Clarifier 4	7,854	601	2136

Existing Final Clarifiers			
Final Clarifier 1	3,318	401	1431
Final Clarifier 2	3,318	401	1431
Final Clarifier 3	10,843	401	1431

Flows (MGD)	
Average	7
Peak	25

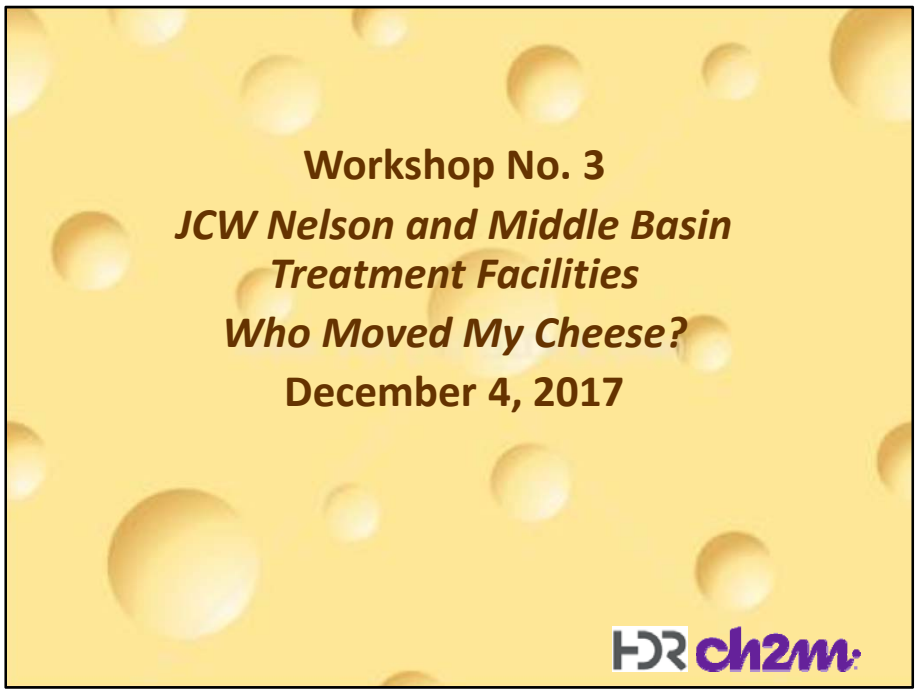
APPENDIX B

Minutes of

Workshop No. 4 - Screening of Alternatives

and

Workshop No. 5 - Analysis of Retained Alternatives



Meeting Minutes are provided here in NOTES

Agenda

- Safety Moment
- Introductions
- Meeting Goals
- Loadings arriving at, or generated by, DLSMB
- Review Results of Analyses under Tasks 5
- Attain Consensus on Solids Loadings
- Screening of Alternatives to Retain for Detailed Analysis
- Review of Nelson Implementation Plan and Business Case for FOG acceptance at Nelson (Follow Up Questions from 11/20/17 Meeting)
- Closing/Next Steps

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Jeanette Klamm	JCW	Jeanette.klamm@jcw.org

Note: Slide above added to reflect attendance list

Safety Moment-Walking on Ice

- Did you know that walking like a penguin can keep you from slipping and falling? When you must walk on ice, walk like a penguin: keep a stable stance with feet shoulder width apart, take short steps, keep your knees loose, and waddle!

Introductions

- JCW Staff
- HDR/CH2M Staff
  - Estell Johnson, Project Manager
  - John Metzler, Principal Technologist
  - Dale Gabel, Principal Technologist
  - Dave Parry, Principal Technologist
  - Brooke Conrardy, Process Modeling
  - Mike Kalis, HDR Contract Administrator

5

Meeting Goals

- Task 5 – Douglas L Smith Middle Basin WWTF Process Capacity and Performance Assessment
- Task 6 – High Level Screening of Douglas L Smith Middle Basin WWTF Alternatives
- Reach Consensus on:
  - Solids projections for DLSMB
  - Selection of alternatives to retain detailed analysis for solids handling
  - Potential alternatives for FOG receiving

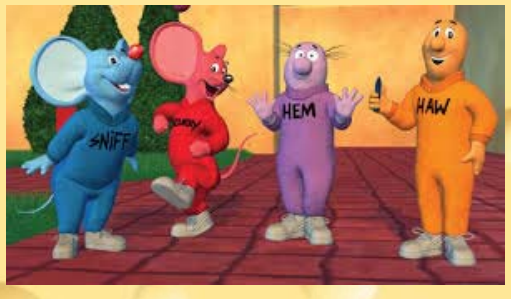
Current and Projected Biosolids and FOG Quantity and Quality Analysis (& Coordination with B&V)

Projections

- FOG
- Off-Site TWAS Hauled
- DLSMB WWTF (Primary and WAS)
- "The Bottom Line"

7

FOG PROJECTIONS



Change Happens: *They Keep Moving The Cheese*

From Workshop 1 - Johnson County Total 2016 Grease Interceptor FOG plus Industrial FOG

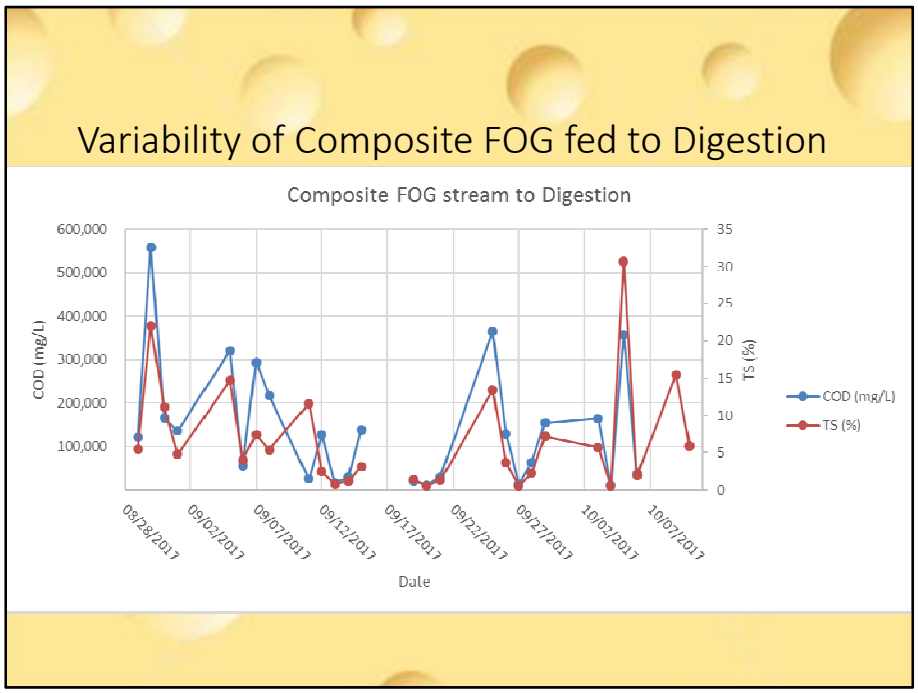
Parameter	Johnson County Grease Interceptor/ Restaurant 2016	Johnson County Industrial 2016	Johnson Co. Total 2016 FOG production
Annual Total (gal/yr)	4,850,000	2,190,000	7,040,000
Concentration [3]			(calculated, flow-weighted, blend)
TS	4	16	7.7%
VS	89	83	
COD	87,000	300,000	
pH	4.4	4.8	
Mass			
TS ppd	4,400	8,000	12,400
Lbs/person/year [1]	2.8	5.0	7.8
AA gpd [2]	13,300	6,000	19,300

(1) Assumes 2016 Johnson Co. population of 580,000 (value actually represents July 2015 census population estimate).
(2) Calendar average, not working days
(3) Not 2016 data. Data used comes from 2007 to 2012 time period

Comparison to B&V Values (October 24, 2017 memo and based on new 2017 Data)

Annual Averages	CH2M Production Assumptions for Evaluation			B&V Production Assumptions for Evaluation		
	Industrial FOG	Brown Grease	Composite/Blend	Industrial FOG	Brown Grease	Composite/Blend
Volume (gpd)	6,000	13,300	19300	6000	12,000	18,000
TS% **ppd**	16% 8,000	4% 4,440	7.7% 12,400	10% 5,000	7.0% 7,000	8.0% 12,000
VS% **ppd**	83% 6,650	89% 3,950	85% 10,600	88.5% 4,430	87.5% 6,130	88% 10,560
COD (mg/L) **ppd**	300,000 15,000	87,000 9,650	153,220 24,700	290,143 14,520	163,527 16,370	205,732 30,890
COD/VS Ratio	2.26	2.44	2.33	3.28	2.67	2.93

Note: B&V columns are based on time period June 6-June 15, 2017 truck sampling. Number of total samples = 32.



Note:

- Figure shows data variability on composite (blended) FOG feed to digesters (COD) from 8/28/17 – 10-10-17. (Does not correspond to truck sampling time period. All based on grab samples).
- COD Avg= 143,000, Avg+SD = 280,000, Median=127,000.
- TS Avg= 7%, Avg+SD = 14%, Median= 5%
- Conclusion is that data is highly variable, and therefore FOG arriving is widely variable. Selecting a “design point” is both challenging and risky.

Proposed Range of FOG Characteristics for current conditions evaluation (Jo.Co. generated)

Annual Averages	Lower End of Range			Upper End of Range		
	Industrial FOG	Brown Grease	Composite/Blend	Industrial FOG	Brown Grease	Composite/Blend
Volume (gpd)	6,000	13,300	19,300	6000	13,300	19,300
TS% **ppd**	16% 8,000	4% 4,440	7.7% 12,400	10% 5,000	7.0% 7,800	7.9% 12,800
VS% **ppd**	83% 6,650	89% 3,950	85% 10,600	88% 4,400	89% 6,900	89% 11,300
COD (mg/L) **ppd**	300,000 15,000	87,000 9,650	153,200 24,700	290,000 14,500	160,000 17,800	200,000 32,300
COD/VS Ratio	2.26	2.44	2.33	3.3	2.6	2.9

Note:

- To address some of the risks of the data variability, a range of FOG characteristics was proposed to be evaluated.
- “lower end of range” represents values proposed by CH2M in Workshop No. 1
- “upper end of range” closely replicates concentrations proposed by B&V in most recent TM prior to Workshop, but applies those concentrations to the volumes projected by CH2M in Workshop No. 1.
- As a “rule of thumb” check, the COD/VS ratio of FOG is expected to be near 3.0

From Workshop 1 – Projected 2030 Quantity from all FOG sources

Parameter	Johnson Co. 2030 Grease Interceptors	Johnson Co. Industrial FOG	Total Johnson Co. only FOG Sources	Metro Area 2030 Grease Interceptors	Metro Area 2030 plus Johnson Co. Industrial FOG
Population Served	730,000	NA	730,000	2,300,000	2,300,000
Lbs TS/person/year	2.8	NA		2.8	
TS ppd	5,600	10,000	15,600	17,600	27,600
Concentration TS %	4 - 7.5	20		4 - 7.5	
AA gpd [1]	16,800 - 9,000	6,000	22,800 – 15,000	52,900 – 28,200	58,900 – 34,200

(1) Calendar average, not working days

Potential Range of FOG Characteristics for future (2030 total metro area) evaluation

Annual Averages	Lower End of Range			Upper End of Range		
	Industrial FOG	Brown Grease	Composite/Blend	Industrial FOG	Brown Grease	Composite/Blend
Volume (gpd)	6,000	52,900	58,900	6000	52,900	58,900
TS% **ppd**	16% 8,000	4% 17,600	5.2% 25,600	10% 5,000	7% 30,900	7.3% 35,900
VS% **ppd**	83% 6,600	89% 15,700	87% 22,300	88% 4,400	89% 27,500	89% 31,900
COD (mg/L) **ppd**	300,000 15,000	87,000 38,400	109,000 53,400	290,000 14,500	160,000 70,600	173,000 85,100
COD/VS Ratio	2.3	2.4	2.4	3.3	2.6	2.7

Note:

- Again, “lower end of range” represents values proposed by CH2M in Workshop No. 1
- And “upper end of range” closely replicates concentrations proposed by B&V in most recent TM prior to Workshop, but applies those concentrations to the future volumes projected by CH2M in Workshop No. 1.
- The higher concentrations also impact the TS lbs per capita of brown grease FOG from Workshop No. 1 (from 2.8 lbs/person/year to 4.9 lbs/person/year. It was noted in Workshop No. 1 that the 2.8 lbs/person/year was considered to be low)

Hauled TWAS from Off-Site

Anticipate Change:
Get Ready For The Cheese To Move

From Workshop 1 – Projected Future Off-Site TWAS Quantities

Parameter	BRM	NCAC	Total TWAS
lbs TWAS /MG Treated	1,200 (1)	4,500 (1)	
Rated Capacity (MGD)	10.5 (2)	1.65 (3)	
Design AA TWAS (ppd)	12,600	7,400	20,000 ppd (AA)

(1) Average of most recent 2 years (2015 and 2016 data), rounded to the nearest hundred, was selected for use in projections.
(2) Based on 3 trains, 3.5 mgd of capacity each. It is assumed that when capacity of existing facility is exceeded, solids handling facilities will be constructed with the expansion and TWAS hauling from BRM will cease.
(3) Based on rated capacity for Alternative 2 Improvements as described in Nutrient Removal Study, New Century Air Center WWTP (Black & Veatch, October 2013).

2016 Off-Site TWAS Available vs. Future 2030 Projections

Annual Averages	2016			Projected Future		
	BRM	NCAC	Total	BRM	NCAC	Total
Volume (gpd)	19,000	10,000	29,000	35,000	21,000	56,000
TS%	4.3%	4.3%	4.3%	4.3%	4.3%	4.3%
ppd	6,800	3,600	10,400	12,500	7,500	20,000
VS%	75%	75%	75%	75%	75%	75%
ppd	5,100	2,700	7,800	9,400	5,600	15,000
COD (mg/L)	36,000	36,000	36,000	36,000	36,000	36,000
ppd	6,000	3,000	9,000	11,000	6,000	17,000
COD/VS Ratio	1.1	1.1	1.1	1.1	1.1	1.1

DLSMB WWTF Generated Solids

Monitor Change:
Smell The Cheese Often So You Know When It Is Getting Old

DLSMB WWTF

- Based primarily on Lablite Data
- CH2M values based on originally collected dataset (9/1/14-10/28/16)
- Evaluated primary sludge production and WAS sludge production
- Evaluated production at both current plant flows (11.45 MGD) and potential at full plant rated capacity (14.5 MGD)

Data Interpretation for Middle Basin TWAS Production

	2015 Average (from data provided to B&V)			
	UWAS to Centrifuge	**TWAS from Centrifuge (Including Hauled)**	**Hauled TWAS**	**Plant TWAS (Adopted)**
Flow (gpd)	293,755	43,500 (Flow Meter)	22,400	21,100
TS (ppd)	9080	(?)	8,000	8,400[1]
Solids Conc (%)	0.36 - 0.39%	6.7% (Grab Sample Data)[2]	4.3%	4.8%

(1) Based on given UWAS going to the centrifuge and 90-95% solids capture, we would expect approx. 8,200-8,600 ppd TS, giving a range of 4.6-6.3% TS.

(2) Some readings from centrifuge indicate error, including measurements of TS as high as 31.8% (March 16, 2015). Reports that the plant is unable to pump sludge from the centrifuge at TS concentrations greater than 6%

20

Note:

- JCW believes that some incorrect data is included in the TWAS data set (for example: The abnormally high TS values may be results from the BFP discharge TS that were entered in the wrong location)
- TWAS from centrifuge is metered, but also includes the volume of hauled TWAS accepted
- Hauled TWAS to MB reflects 2015 values found in Table 10 of data analysis TM (March 27, 2017) which were obtained by data analysis and some assumptions (not exact)

Adopted Plant Solids Production

Annual Averages	2015 Production (from originally collected data provided)		2030 Projected Production	
	Fermented Sludge from Gravity Thickener	TWAS from Middle Basin Centrifuge	Fermented Sludge from Gravity Thickener	TWAS from Middle Basin Centrifuge
Plant flow, MGD	11.45		14.5	
TSS, ppd	7,600	8,400	9,600	10,600
Solids Conc. %	2.7	4.8 (calculated)	2.7	4.8
Volume, gpd	33,800	21,100	42,600	26,700

21

Note: represents values proposed by CH2M based on data analysis in Task 1

Comparison to B&V Values (October 24, 2017 memo and based on new 2017 Data)

Annual Averages	CH2M Production Assumptions for Evaluation			B&V Production Assumptions for Evaluation		
	Fermented Sludge from Gravity Thickener	TWAS from Middle Basin Centrifuge	Total	Fermented Sludge from Gravity Thickener	TWAS from Middle Basin Centrifuge	Total
Digestion – Active Volume	1.8MG			1.7MG		
Volume, gpd	33,800	21,100	54,900	30,000	28,000	58,000
TS% **ppd**	2.7% 7,600	4.8% 8,400	3.51% 16,000	2.6% 6,500	6.0% 14,000	4.24% 20,500
VS% **ppd**	84.4% 6,400	78.5% 6,600	81.3 13,000	84% 5,500	78% 10,900	80% 16,400
COD (mg/L) **ppd**	44,000 12,400	36,000 6,300	40,900 18,700	38,300 9,600	31,900 7,400	35,200 17,000
COD/VS Ratio	1.9	1.0	1.4	1.8	.7	1.0

Notes:

- B&V TWAS from Middle Basin centrifuge volume of 28,000 gpd may be more accurate as new 2017 data reflects a time period where no hauled TWAS from off-site was being accepted at Middle Basin.
- Expect COD/VS ratio of plant solids to be 1.5 for blended stream.
- With B&V production assumptions not producing the expected COD/VS ratio, CH2M production assumptions will continue to be used
- However, “what if” scenarios are evaluated to quantify the potential impact of actual TWAS production values matching the B&V assumptions

“The Bottom Line”

Adapt To Change Quickly:
The Quicker You Let Go Of Old Cheese, The Sooner You Can Enjoy New Cheese

Solids Projections Evaluated

- Current Solids Projections
  - Current DLSMB WWTF at 11.45 MGD
  - Hauled TWAS (optional)
  - Current FOG (low and high range of concentrations)
- Total 2030 Solids Projections
  - DLSMB WWTF at 14.5 MGD capacity
  - Hauled TWAS (optional)
  - 2030 Metro Area FOG (one end of range only)

The “Bottom Line”

	Middle Basin Only – Current WWTP	Middle Basin (current) plus FOG	Middle Basin Only – Future Onsite Production	Middle Basin (Future) plus FOG
AA				
DLSMB Primary Sludge	7,600 ppd 2.7% TS 84.4% VS	7,600 ppd 2.7% TS 84.4% VS	9,600 ppd 2.7% TS 84.4% VS	9,600 ppd 2.7% TS 84.4% VS
DLSMB TWAS	8,400 ppd 4.8% TS 78.5% VS	8,400 ppd 4.8% TS 78.5% VS	10,700 ppd 4.8% TS 78.5% VS	10,700 ppd 4.8% TS 78.5% VS
FOG		12,400 ppd-12,800 7.7-7.9% TS 85-89% VS		25,600 -35,900ppd 5.2-7.3% TS 87-89% VS
Total	16,000 ppd 3.5% TS	28,400-28,800 ppd 4.6-4.7% TS	20,300 ppd 3.5% TS	45,900 – 56,200 ppd 4.3-5.3% TS
MM				
DLSMB Primary Sludge	9,100 ppd 2.7% TS 84.4% VS	9,100 ppd 2.7% TS 84.4% VS	11,500 ppd 2.7% TS 84.4% VS	11,500 ppd 2.7% TS 84.4% VS
DLSMB TWAS	10,100 ppd 4.8% TS 78.5% VS	10,100 ppd 4.8% TS 78.5% VS	12,800 ppd 4.8% TS 78.5% VS	12,800 ppd 4.8% TS 78.5% VS
FOG		14,900-15,400 ppd 7.7-7.9% TS 85-89% VS		33,100-43,000 ppd 7.0-7.3% TS 87%-89% VS
Total	19,200 ppd 3.5% TS	34,100 -34,600 ppd 4.6-4.7% TS	24,400 ppd 3.5% TS	57,500 -67,400ppd 4.9%-5.3% TS

Observations on "Bottom Line" Projections

- Hauled TWAS not currently in table, but will be evaluated. It was estimated that DLSMB accepted up to 9600 ppd of off-site TWAS in 2015
- FOG in Bottom Line is total projected to be available, not what is able to be accepted
- 30% Rule (max of 30% of COD from FOG) was followed in Nelson Evaluation
- Increase in flows to DLSMB from current 11.45 to design 14.5 MGD seems unlikely given mature service area? Evaluations focus on current flow

26

Note:

- While hauled TWAS is not included in the table, subsequent slides evaluate if having MB receive some % of TWAS will optimize FOG acceptance.
- Similar to Nelson, Middle Basin cannot receive all Metro FOG without violating the "30% rule". Previously quantified how much FOG Nelson can take, now evaluating MB FOG acceptance capacity
- Buildout to 14.5 MGD is unlikely. Discussion in workshop was that 13.8 might be the rated capacity. There is not much growth potential in the service area.
- Concentrations of Middle Basin influent flows may be going up but flow is not going up, maybe decreasing.
- Terry agreed at workshop to look into service area and find how much land remains available for new development. Subsequent findings from Terry (e-mail correspondence following Workshop) is that only 4.2% of the total Middle Basin service area remains as developable ground. Terry provided direction on 12-21-17 to use 12.0 mgd as the future influent flow to the facility.

Max Month – Limitations on Max Feed FOG %

TS Received (ppd)	DLSMB Current Sludge Only Low Strength FOG	DLSMB Current Sludge Plus Hauled TWAS Low Strength FOG	DLSMB Current Sludge Only High Strength FOG	DLSMB Current Sludge Plus Hauled TWAS High Strength FOG
DLSMB	19,200 ppd	19,200 ppd	19,200 ppd	19,200 ppd
Trucked in TWAS	0	9,600 ppd	0	9,600 ppd
FOG	4,800 ppd 7,500 gpd (32% of Current)	7,400 ppd 11,500 gpd (50% of Current)	3,800 ppd 5,700 gpd (26% of Current)	5,100 ppd 7,700 gpd (34% of Current)

Limitation is to not exceed maximum of 30% FOG feed COD/Total feed COD

27

Note:

- Columns that include "Plus Hauled TWAS" reflect the quantity of TWAS that was accepted at Middle Basin in 2015 (not total available TWAS)
- "% of current" in bottom FOG row is defined as % of the MM FOG from slide 25 (the "Bottom Line") table, or the % of FOG estimated to be currently generated by Johnson County.
- Typically, MM would be more conservative, but with the FOG ratio controlled by the total mass of the digester feed, having less mass under AA to balance out the FOG results in AA being more conservative (limiting) for FOG receiving. Under Annual Average Conditions, DLSMB produces approximately 16,000 ppd of sludge, limiting the FOG acceptance capability WITHOUT additional hauled TWAS acceptance to:
    - Lower Strength FOG: 4,000 ppd (6200 gpd)
    - Higher Strength FOG: 3,100 ppd (4000 gpd)

Task 5 – DLSMB Process Capacity Assessment

Change: *Move With The Cheese*

Summary of Existing Digestion Facilities

- Three Primary 0.53 MG digesters, and One Secondary 0.26 MG Digester
- Diameter 55ft
- Sidewater depth
  - Primary 34ft
  - Secondary 15ft
- Modeled active volume: 1.8 MG

Peak Two Week–Pass/Fail for Existing Digestion Facilities, All Digesters in Service

TS Received (ppd)		DLSMB Current ONLY	DLSMB Future ONLY
DLSMB		22400 ppd	28400 ppd
TWAS		0	0
FOG		0	0
Fail Criteria			
HRT/SRT	<15 Days	24.0	18.9
VSLR	>0.15	0.07	0.09
SVSLR	>0.16	0.08	0.10
S COD LR	>0.25	0.11	0.14
COD FOG/Total	>0.30	0	0
VS Reduction		47.4	47.4
TS Leaving	>3.2%	2.15	2.16

Current Peak Two Week–Pass/Fail for Existing Digestion Facilities, All Digesters in Service

TS Received (ppd)		DLSMB Current with lower strength FOG	DLSMB Current with higher strength FOG
DLSMB		22400 ppd	22400 ppd
TWAS		0	0
FOG		5100 ppd 8700 gpd	3900 ppd 6700 gpd
Fail Criteria			
HRT/SRT	<15 Days	21.9	22.0
VSLR	>0.15	0.09	0.09
SVSLR	>0.16	0.11	0.10
S COD LR	>0.25	0.17	0.17
COD FOG/Total	>0.30	0.30	0.30
VS Reduction		56.7	55.0
TS Leaving	>3.2%	2.06	2.08

31

Current Max Month –Pass/Fail for Existing Digestion Facilities, One Digester Out of Service

TS Received (ppd)		DLSMB Current with lower strength FOG	DLSMB Current with higher strength FOG
DLSMB		19200	19200
TWAS		0	0
FOG		4800 ppd 7500 gpd	3800 ppd 5700 gpd
Fail Criteria			
HRT/SRT	<15 Days	18.0	18.4
VSLR	>0.15	0.11	0.11
SVSLR	>0.16	0.13	0.12
S COD LR	>0.25	0.21	0.21
COD FOG/Total	>0.30	0.30	0.30
VS Reduction		57.4	58.6
TS Leaving	>3.2%	2.07	2.11

Task 6 – DLSMB Alternative High-Level Screening

Change: *(Keep moving) With The Cheese*

Alternative A – Accept Hauled TWAS

- Limiting parameter is the 30% Rule for FOG COD
- HRT/SRT and loading criteria limits are not being reached
- To increase ability to accept more FOG, accepting some hauled TWAS again at DLSMB could be considered

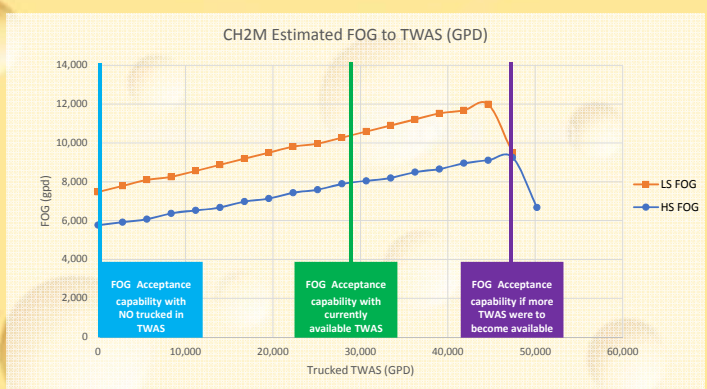
Max Month –Alternative A, Accept Hauled TWAS
Acceptance of TWAS to Increase FOG Acceptance (MM, all in service), LS=Lower Strength FOG, HS=Higher Strength FOG

	Current w/ Lower Strength FOG	Current w/Higher Strength FOG	Current LS FOG Optimized Hauled TWAS	Current HS FOG Optimized Hauled TWAS	B&V Plant TWAS, LS FOG Optimized Hauled TWAS	B&V Plant TWAS, HS FOG Optimized Hauled TWAS
DLSMB TS (ppd)	19,200	19,200	19,200	19,200	23,100	23,100
Hauled TWAS (ppd) (gpd)	0	0	16,000 44,600	17,000 47,400	15,000 41,800	14,000 39,000
FOG (ppd) (gpd)	4800 7500	3800 5700	7700 12000	6100 9300	7500 11700	6000 9100
Controlling Parameter/ Fail Criteria	FOG COD %	FOG COD %	HRT/SRT	HRT/SRT FOG COD %	VSLR HRT/SRT	VSLR

Note:

- Accepting hauled TWAS increases capacity for FOG until other loading criteria (fail criteria) are reached.
- gpd value has been added to the Hauled TWAS row since the workshop

Optimized TWAS Addition for Max FOG Acceptance – MM



Note:

- Only 29,000 gpd of trucked TWAS is projected to be currently available from BRM and NCAC (green vertical line added to graph to identify that limitation)
- Up to 56,000 gpd of trucked TWAS is projected to be available in the future if BRM and NCAC produce at their max rated capacity
- Accepting trucked TWAS increases the capacity for FOG until other loading criteria fail, detailed on the previous slide. The purple vertical line has been added to indicate the limitation.

Alternative A – Accept Hauled TWAS-Observations

- Hauled TWAS to DLSMB can enhance capacity for FOG by as much as 50%
- Diverting TWAS from Nelson reduces capacity of proposed FOG receiving there

Alternative B – Recuperative Thickening

- Limiting parameter is the 30% Rule for FOG COD.
- HRT/SRT and loading criteria limits are not being reached
- Recuperative thickening increases SRT, but SRT is not a limiting factor
- Recuperative thickening does not increase ability to accept more FOG

Note:

- Recuperative thickening is not helpful at meeting the specific criteria of this evaluation because we fail on other criteria besides SRT
- However, recuperative thickening is beneficial for other purposes, such as addressing variability of influent steams and addressing scenarios where digester contents have become too thin (ex TS under 2%). Keeping the secondary digester contents at or above 2% optimizes dewatering.

Alternative C – Convert Secondary to Primary and add separate Digested Sludge Storage

- Would require additional tankage/footprint
- Since limiting factor is 30% COD loading from FOG, additional volume does not increase capacity for accepting FOG unless additional trucked TWAS is also accepted

Alternative C
Construct Separate Digested Sludge Storage, Use Existing Secondary as Primary

MM - One Digester Out of Service	Current Onsite w/ Lower Strength FOG	Current Onsite w/Higher Strength FOG
DLSMB TS (ppd)	19,200	19,200
Hauled TWAS (ppd)	0	0
FOG (ppd) (gpd)	4700 7400	3800 5700
Controlling Parameter/ Fail Criteria	FOG COD %	FOG COD %

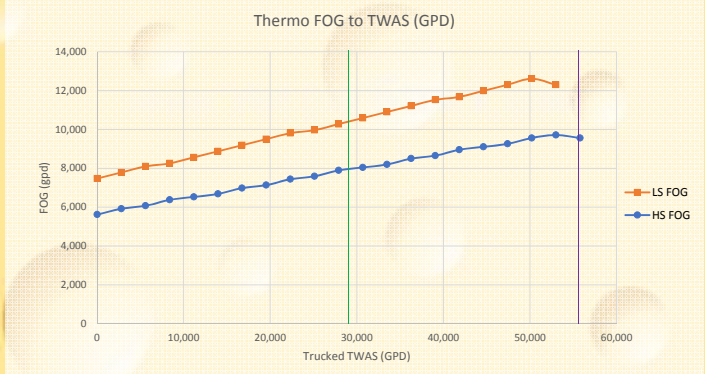
Note:

- There is no change to the FOG acceptance capacity in this alternative unless there is TWAS acceptance
- However, redundancy would be increased by having 4 primary digesters available

Alternative D – Convert Two Primary Digesters to Thermophilic

- Convert two (2) of the primary mesophilic digesters to thermophilic in parallel
- One mesophilic digesters would follow thermophilic, and variable volume digester would remain as sludge storage before digestion
- Due to the higher temperatures, the solids retention time required for a Class B biosolids product is reduced to 8 days. The higher rate process can also accept 20-50% higher loading rates than the mesophilic
- Minimally increases ability to accept more hauled TWAS and therefore accept more FOG within the 30% Rule (based on assumption of only converting 2 digesters)

Alternative D
Thermophilic Digestion



Note:

- 29,000 gpd of trucked TWAS is projected to be currently available from BRM and NCAC (green vertical line) and up to 56,000 gpd of trucked TWAS is projected to be available in the future (purple vertical line)
- With only 2 primary digesters converted to thermophilic, the increased capacity for FOG is insignificant (peak on the orange-LS line occurs at 13,000 gpd rather than 12,000 gpd)
- To see significant increased capacity, all 3 primary digesters would need to be converted to thermophilic.

Alternative E – Waive 30% Rule and allow up to 50% of influent COD to be from FOG

- Up to 50% of influent COD has been found to be possible in the lab and at some operational facilities
- However, it is believed to be a maximum condition and therefore risky and potentially unstable

Max Month –Alternative E, Waive 30% Rule
Acceptance of TWAS to Increase FOG Acceptance (MM, all in service), LS=Lower Strength FOG, HS=Higher Strength FOG

	Current w/ Lower Strength FOG	Current w/Higher Strength FOG	Current LS FOG Optimized Hauled TWAS	Current HS FOG Optimized Hauled TWAS	B&V Plant TWAS, LS FOG Optimized Hauled TWAS	B&V Plant TWAS, HS FOG Optimized Hauled TWAS
DLSMB TS (ppd)	19,200	19,200	19,200	19,200	23,100	23,100
Hauled TWAS (ppd) (gpd)	0	0	3,000 8,400	5,000 13,900	9,000 25,100	10,000 27,900
FOG (ppd) (gpd)	11200 17400	8900 13500	12400 19300	10300 15600	13600 21200	11300 17500
Controlling Parameter/ Fail Criteria	FOG COD %	FOG COD %	CODLR	CODLR	VSLR	VSLR

Note:

- Table values are based on allowing 50% of influent COD to be from FOG (rather than 30%) as a "what-if" scenario
- gpd value has been added to the Hauled TWAS row since the workshop
- At 18,000 gpd of FOG acceptance, the FOG % of influent COD ratio is pushed beyond 50% unless some hauled TWAS is accepted.
- Note that the subtle differences between CH2M and B&V characterizations result in different fail criteria being the controlling parameter when hauled TWAS is accepted.
- It was discussed that while cyclically stressing digesters has shown good results in the lab, it can be operationally difficult due to high degree of uncertainty in FOG feed material.
- Sustaining FOG acceptance at or above 50% of influent COD from FOG is <u>NOT RECOMMENDED</u>. Limiting FOG to 30% FOG feed COD/Total feed COD (per slides 27 and 36) is recommended.

Selection of alternatives to retain for detailed analysis

Enjoy Change! *Savor The Adventure And Enjoy The Taste Of New Cheese!*

Middle Basin WWTF Identification and Definition of Alternatives-High Level Screening

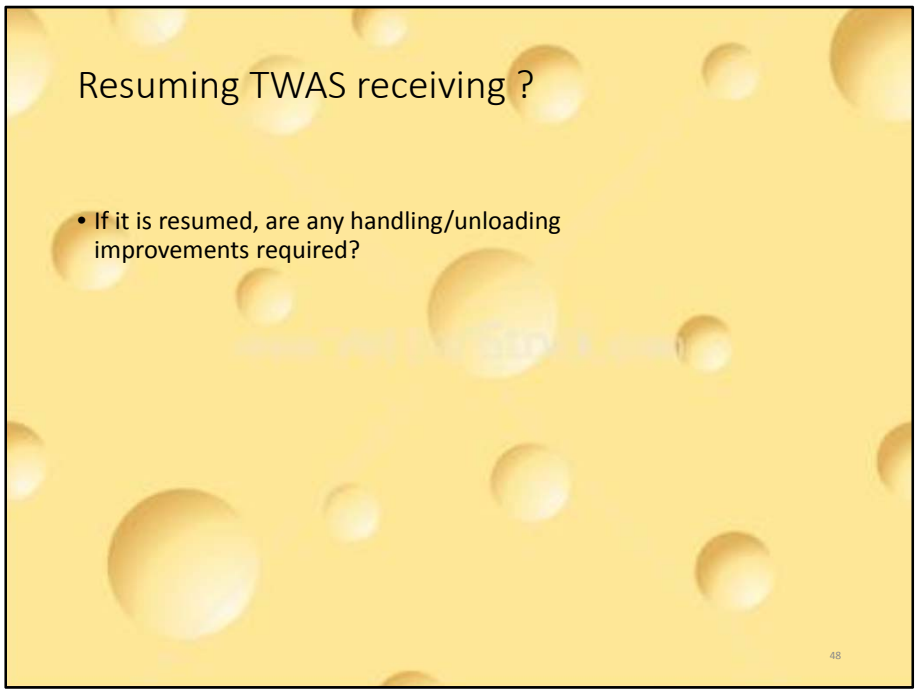
- Select maximum of two Alternatives per process to retain for Detailed Evaluation:
  - BRM1 and NCAC TWAS receiving
  - FOG waste receiving and handling
  - Anaerobic digestion

Biosolids Use Current Practice
Land Application of Class B Biosolids

- Dewatered, digested, Class B biosolids are land applied by contract haulers
- Current Practice at Middle Basin
- The facility is able to handle current and future production biosolids with one digester out of service

47

Note: It was agreed that land application of Class B biosolids will continue and no other alternatives for biosolids utilization need to be evaluated



Note:

- Existing TWAS pumps are being completely replaced.
- It is desired to avoid re-thickening (example: do not unload into UWAS tank upstream of centrifuge thickening)
- address accepting TWAS 5 days a week but feeding it to digesters 7 days/week. Long term goal would be to get storage. Short term possibility is to address operationally and get staff to haul over the weekend
- Develop budget for constructing storage to accommodate 5day/week and feeding 7day/week
- Consider minor design changes that can make TWAS hauling easier ex: tip truck unloading to gravity unload
- Before including TWAS changes in CIP, JCW will plan to test with a few trucks and include a CIP value once improvement is observed in the digesters
- Accepting TWAS can cause more foaming, and was noted as a potential concern

FOG receiving and handling Enhancements

- Improvements/enhancments at DLSMB per B & V April 4,2017 Memo:
  - 1 Replace digester feed valves
  - 2 Install a motor with a 20:1 constant torque turndown on each of the gravity thickened sludge pumps
  - 3 Replace TWAS pump motors with new ones rated for a 20:1 constant torque turndown
  - 4 New instrumentation on digester mixing pumps suction pipe and the sludge pipe upstream of each heat exchanger
  - 5 Investigation of the capabilities and limitations of the hot water loop
  - 6 Relocate digester feed line so FOG is introduced downstream of heat exchangers
  - 7 Install thermal dispersion mass flow meters on each primary digester gas takeoff for continuous monitoring through SCADA
  - 8 Install new PLC cabinet in Digester Control Building for new inputs for additional process monitoring and control
  - 9 Consider implementing FOG tank mixing improvements recommended by CDM Smith
  - 10 Evaluate existing mixing system to determine if modification of mixing nozzle placement will help reduce foaming and rapid rise events
  - Others?

49

Notes:

1. Digester feed valves are being addressed – in process
2. New motor?
3. TWAS pumps are being completely replaced
4. Instrumentation: Temperature sensors now installed on mixing side of pumps
5. Hot water loop investigations: Ongoing, found screen in system that requires routine maintenance, also investigating system leaks. Corroded tubes in heat exchanger are a possible cause. Suspect there is a leak in the north loop, being monitored, developing plans for how to test better.
6. In process of moving pipe to downstream of heat exchangers
7. Thermal dispersion mass flow meters: identified spots for gas to have flow meters, on the list but not addressed. Flow meters that measure flow and methane content are being investigated as an alternative to thermal dispersion type. Adding instruments is currently limited by I/O points – see below.
8. No new PLC installed, requested funding and expect to work with Pedrotti. In the works
9. FOG tank suggestion from CDM: Still on hold until study and results are completed. FOG mixing better since being redirected and increasing the size of the lines. Not getting cap and cone of grit as badly. With concentrating, believe the FOG is “cleaner.” Material stratification is not evident currently. Plan to measure variability via solids meter going to the digester. Still needs evaluation

10. Evaluating mixing system to reduce foaming: nothing done on this yet.

Other needed improvements?

- Bicarbonate feed? JCW feels comfortable with 18,000 gpd FOG acceptance but wants to address alkalinity issue by adding bicarbonate feed capability
- FOG storage? Small haulers have pretty much disappeared.
- Substantial wait times? Not as bad, but some waiting is occurring. Backup caused by single offloading station. Consider additional unloading station as well as additional storage.
- FOG Mixing? Cannot currently mix continuously, new mixing system still needed. JCW already adjusted nozzles and getting less separation/striation
- Bubble has a leak, WesTech believes it is diffusing through the inner membrane and needs to be investigated.
- Cleaning equipment in good shape, the chiller had a recent repair.

Anaerobic Digestion-Proposed Retained Alternatives to Enhance FOG Acceptance

- Accept Hauled TWAS
- Convert two primary digesters to Thermophilic

50

Retained alternatives:

1. Accept Hauled TWAS
2. Convert secondary to primary and build new storage
    - Investigate adding storage that has gas bubble on top of new storage tank

Review of Nelson Implementation Plan and Business Case for FOG acceptance at Nelson

Be Ready To Change Quickly And Enjoy It Again:
They Keep Moving The Cheese

51

Response to Discussion Topics for 11/22/17 Phone Call

- Terry sent CH2M a series of questions
- Questions were based on JCW discussions on 11/20/17 regarding FOG
- Following are preliminary responses to those questions

Can Phase IA (1 digester) meet Class B requirements (e.g. min 15 days SRT) for current Nelson solids and hauled TWAS?

- One digester can handle current Nelson-generated loads
- One digester can also handle some hauled TWAS, up to the quantities from BRM and NCAC in 2015/2016 timeframe
- One digester cannot handle the current Nelson-generated loads plus the projected hauled TWAS with BRM and NCAC at their capacities

Digestion Alternatives-Capacity Analysis 2 Meso plus 1 additional Meso

Scenario Monthly Max Key: 1+1 = 1 Duty, 1 Standby	Current +TWAS	Current +TWAS +FOG	BNR +TWAS	BNR +TWAS +FOG
1 + 1 Meso Digesters = 2 Meso Total	FAIL SRT, VSLR, SVSLR, SCODLR			
2 + 1 Meso Digesters = 3 Meso Total	PASS	PASS 36% of FOG accepted	PASS	FAIL SRT, SCODLR, TS% Leaving
3 + 0 Meso Digesters = 3 Meso Total	PASS	PASS	PASS	PASS 41% of FOG accepted

Does the $5.6M cost for Phase IA include auxiliary digestion facilities/equipment?

- Yes, see pages 4 and 7 of Executive Summary/Implementation Plan
- The $5.6M cost shown on Table 3, page 6 of Implementation Plan is only the first step of Phase 1, not the full recommended Phase 1.
- This cost includes heating, mixing, and piping for Digester 3 and mixing for the existing Sludge Holding Tanks

Notes:

- Phase 1A gets immediate situation taken care of, but does not allow for redundancy or FOG at Nelson
- Assumes all gas gets flared that is not in digestion process, no gas cleaning
- NFPA concerns. Common walls may cause issues and will need 2nd wall to get NFPA separation from digester 3 and existing building. May not be in current cost estimate – will be checked.

Business Case for constructing either a partial or a complete Phase 1

- Besides reliability of landfill option, what are the other drivers?
- Will other Landfills accept Nelson biosolids?
- If other landfills will accept, are they too costly?
- Is there a Plan B for Nelson sludge in Landfill?
- Responses on next Slides

Business Case for Phase 1

- Primary Driver is reliability of landfill option
  - As documented in Executive Summary, landfill option is tenuous due to continued concerns about odors at landfill, and the decision to accept biosolids there rests with the landfill and city, not JCW
  - Under Phase 1, Landfilling becomes Plan B, since if one digester is out of service, Class B is not achievable
  - As documented in Executive Summary, there are social and environmental benefits to Phase 1:
    - Reduced Odors at Landfill and along haul route
    - Beneficial Reuse of biosolids
  - JCW Staff has not been able to find another landfill to accept sludge, so cost is currently unknown, i.e., Lawrence Hamm Quarry, Courtney Ridge
  - At this time, there is no known Plan B for landfilling at the Johnson County Landfill

Note: JCW plans to conduct a survey of landfills in the area to determine if they would accept Nelson biosolids

Business case for adding FOG facilities at Nelson

- Provides redundancy for FOG acceptance when Middle Basin can not accept FOG
- B & V current recommendation is 6,000 gpd industrial plus 4,000 gpd unconcentrated restaurant FOG, or about 1,500 gpd restaurant FOG if concentrated
- JCW plans to operate at 18,000 gpd, which is close to estimate for current JC FOG of 6,000 industrial and 13,000 gpd FOG
- Nelson can accept 31% of current JC FOG (subject to re-evaluation with new data)
- A key driver for FOG acceptance at Nelson is redundancy for FOG acceptance at Middle Basin, decision to operate in unstable range makes this more critical
- Another driver is Nelson FOG facilities are nearly self-funded, tipping fee revenue will likely exceed O & M and P & I costs

Where is all of the regional FOG is going?

- Unknown
- Doug would be the most knowledgeable
- Do other JCW staff managing restaurant grease program have insights?
- Some FOG concentrators such as LES would be decreasing the overall volume, but not the overall loadings of FOG
- Note, Doug's Concerns (HDR/CH2M concurs):
  - Haulers may not be fully truthful, FOG may be going to unapproved outlets
  - Haulers guard confidentiality of their customer list
  - Others?

Note:

- LES concentrated FOG has COD concentration of around 330,000 mg/L
- Gas Production is back up to where it was when over 20,000 gpd was being delivered
- Need to answer: How much does the landfill charge for FOG?

FOG going to DLSMB

- How much of it is concentrated?
  - Based on current concentrations, some portion of restaurant FOG is likely being concentrated at LES facility
  - Doug believes some haulers are taking restaurant FOG to LES for concentrating
- Should we be identifying this?
  - This would be beneficial, impact on digesters is the pounds of FOG (VS, COD),not the gallons of FOG that are fed to digesters
- Should charging/regulating/limiting FOG deliveries be based on solids loading, rather than volume?
  - This is recommended, as noted above, mass loading is limiting, of the FOG receiving facility would be somewhat proportional to the mass received.
  - Similar to many other FOG receiving facilities, recommend testing a portion of loads to confirm FOG type (restaurant, industrial, concentrated, etc.) and to assure loads are not unapproved material. Sampling, but not testing every load helps assure compliance

Re-visit JCW's FOG tipping fees

- Can HDR/CH2M perform a review of FOG tipping fees?
  - Currently not in scope
  - HDR/CH2M can provide analysis and recommendations
- JCW suggested sensitivity analysis, rather than a full-blown rate study
  - Need further clarification
- How does our fee compare to other fees in the region?
  - Currently not in scope, but HDR/CH2M can provide data
- Should the fees take into consideration whether the FOG is concentrated?
  - As noted previously, this is a concept that should be considered

Note: HDR/CH2M can compare JCW tipping fees to landfill disposal. JCW is considering requesting a scope and fee for FOG tipping fee survey and update.

Closing and Next Steps

Be Ready To Change Quickly And Enjoy It Again:
They Keep Moving The Cheese

62

Note:

- JCW proposed to test impact of trucked TWAS acceptance at Middle Basin. Based on Slide 44, accepting 3000 – 5000 ppd of trucked TWAS (8400 – 14000 gpd) could be possible. JCW will likely trial at 1-2 trucks per day.
- JCW will pursue identifying a Plan B to current landfill.

Closing and Next Steps

- Next Steps
  - Task 7 –DLSMB WWTF Detailed Analysis and Costs for Recommended Alternatives
  - Task 8 – FOG Management Policy Development
  - Workshop No. 4 (Discuss Task 7 Results)-February 2018?

THANK-YOU

- Questions?
- Concerns?
- Was this meeting of value?
- Other feedback?

64

Meeting Minutes are provided here in NOTES

It's a Wrap!

Agenda

- Safety Moment
- Introductions
- Meeting Goals
- Review Results of Analyses under Task 7-Middle Basin Alternatives
- Review Nelson TWAS Optimization
- Review FOG Management Policy Evaluations
- Closing/Next Steps

Safety Moment-Tornadoes

- Tornadoes strike most often between March and June in the central United States. But they've been reported in all 48 continental states, at all times of the year. So no matter where you live, you need to be prepared!
- Seek shelter immediately!
  - If you're away from home, your best bets are basements or interior corridors of office buildings, tunnels, underground parking lots or subways. Avoid auditoriums, upper stories of office buildings, trailers and parked vehicles. And stay away from windows.
- If you're out in the open, lie flat in a ditch or other low-lying area and protect your head. Stay away from poles and overhead lines.
- If you're driving, drive at right angles to the tornado's path. If you can't escape the path of the tornado, get out of the vehicle to avoid being overturned and crushed.
- If you're at home, head for the basement and take cover under a heavy table or workbench. If you don't have a basement, go into a windowless room in the center of the house. If that's not possible, stay away from windows and cover yourself with a rug for protection against flying glass and debris.

Safety Moment-Tornadoes, cont.

- Know the difference between a watch and a warning.
  - A tornado watch means conditions are right for the formation of a tornado. Stay alert, and be prepared to take shelter.
  - A tornado warning means a tornado has been spotted in your area. Take shelter immediately!

Introductions

- JCW Staff
- HDR/CH2M Staff
  - Estell Johnson, Project Manager
  - John Metzler, Principal Technologist
  - Dale Gabel, Principal Technologist
  - Brooke Conrardy, Process Modeling
  - Mike Kalis, HDR Contract Administrator

5

Meeting Goals

- Review Results of Task 7 – Douglas L Smith Middle Basin WWTF Detailed Analysis and Costs for Recommended Alternatives
- Review Results of Task 8-FOG Management Policy Development
- Reach Consensus on:
  - Solids handling alternative for DLSMB
  - Optimization of TWAS for FOG acceptance

6

Brief Recap of Current and Projected Biosolids and FOG Quantity and Quality Analysis (and Coordination with B&V)

Projections

- FOG
- Off-Site TWAS Hauled
- DLSMB WWTF (Primary and WAS)
- "The Bottom Line"

7

The Updated "Bottom Line" – Annual Average

	Middle Basin Only @ 12.0 mgd	Middle Basin @ 12.0 mgd plus Max HS FOG	Middle Basin @12.0 mgd plus Max HS FOG plus Max Hauled TWAS
AA			
DLSMB Primary Sludge	8,000 ppd 2.7% TS, 84.4% VS 35,000 gpd	8,000 ppd 2.7% TS, 84.4% VS 35,000 gpd	8,000 ppd 2.7% TS, 84.4% VS 35,000 gpd
DLSMB TWAS	12,000 ppd 4.8% TS, 78.5% VS 30,000 gpd	12,000 ppd 4.8% TS, 78.5% VS 30,000 gpd	12,000 ppd 4.8% TS, 78.5% VS 30,000 gpd
FOG		4,000 ppd 7.3% TS, 89% VS 7,000 gpd	6000 ppd 7.3% TS, 89% VS 9,000 gpd
Hauled TWAS		0	15,000 ppd 4.3% TS, 75% VS 42,000 gpd
Total	20,000 ppd 3.7% TS, 81% VS 65,000 gpd	24,000 ppd 4.0% TS, 82% VS 72,000 gpd	41,000 ppd 4.2% TS, 80% VS 116,000 gpd

8

The Updated "Bottom Line" – Max Month

MM	Middle Basin Only @ 12.0 mgd	Middle Basin @ 12.0 mgd plus Max HS FOG	Middle Basin @12.0 mgd plus Max HS FOG plus Max Hauled TWAS
DLSMB Combined Sludge	24,000 ppd 3.7% TS, 81% VS 78,000 gpd	24,000 ppd 3.7% TS, 81% VS 78,000 gpd	24,000 ppd 3.7% TS, 81% VS 78,000 gpd
FOG		5,000 ppd 7.3% TS, 89% VS 8,000 gpd	7,000 ppd 7.3% TS, 89% VS 11,000 gpd
Hauled TWAS			18,000 ppd 4.3% TS, 75% VS 50,000 gpd
Total	24,000 ppd 3.7% TS, 81% VS 78,000 gpd	29,000 ppd 4.0% TS, 82% VS 86,000 gpd	49,000 ppd 4.2% TS, 80% VS 139,000 gpd

Observations on Revised "Bottom Line" Projections

- Increase in flows to DLSMB from current 11.45 to 12.0 MGD is adopted
- Workshop 3 used a range of plant-generated TWAS (CH2M numbers vs. B&V values.) Bottom-Line revised to a midpoint.
- 30% Rule (max of 30% of COD from FOG) is being followed
- It was estimated that DLSMB accepted up to 9600 ppd of off-site TWAS in 2015

10

Note:

- Findings from Terry (e-mail correspondence following Workshop) is that only 4.2% of the total Middle Basin service area remains as developable ground. Terry provided direction on 12-21-17 to use 12.0 mgd as the future influent flow to the facility.

Middle Basin Digestion Alternatives

Summary of Existing Digestion Facilities

- Three Primary 0.53 MG digesters, and One Secondary 0.26 MG Digester
- Diameter 55ft
- Sidewater depth
  - Primary 34ft
  - Secondary 15ft
- Modeled active volume: 1.8 MG

Feedback from Workshop No. 3

Retained alternatives:

A. Accept Hauled TWAS
   - Provide adequate equalization to allow unloading 5 days/wk, 8 hrs per day but feed digesters 7 days/wk, 24 hrs per day.

B. Convert secondary to primary and build new storage
   - Investigate adding storage that has gas bubble on top of new storage tank

Note:

- Testing of impacts of accepting hauled TWAS again at DLSMB did occur. Foaming and VA/alkalinity ratio issues occurred when accepting TWAS, but only in secondary (not primaries). JCW suspects a bypass of raw feed directly to the secondary may have occurred, potentially through the emergency overflow piping connecting the primaries to the secondary.
- JCW staff reported that although sludge heating and mixing is available for Secondary Digester No. 2, heating is not currently conducted and the mixing is only used during dewatering operations. Under these conditions, the digester volume of Digester No. 2 should not be considered as active volume for purposes of determining total digestion capacity.

Alternative A – Accept Hauled TWAS

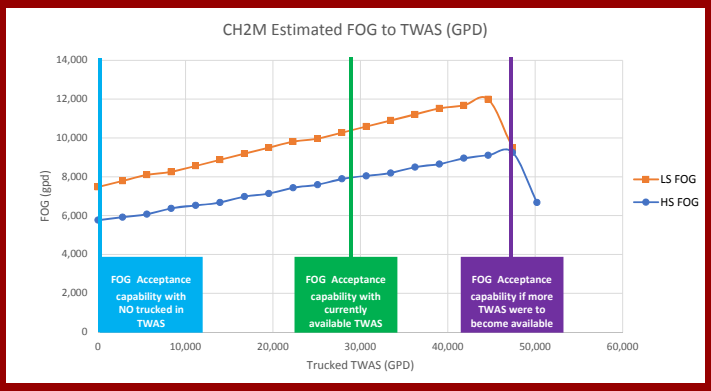
- Limiting parameter is the 30% Rule for FOG COD
- HRT/SRT and loading criteria limits are not being reached
- To increase ability to accept more FOG, evaluated optimal amount of hauled TWAS

Feedback on TWAS Receiving from Workshop 3

- Existing TWAS pumps are being completely replaced.
- It is desired to avoid re-thickening (example: do not unload into UWAS tank upstream of centrifuge thickening)
- address accepting TWAS 5 days a week but feeding it to digesters 7 days/week. Long term goal would be to get storage. Short term possibility is to address operationally and get staff to haul over the weekend
- Develop budget for constructing storage to accommodate 5day/week and feeding 7day/week
- Consider minor design changes that can make TWAS hauling easier ex: tip truck unloading to gravity unload
- Before including TWAS changes in CIP, JCW will plan to test with a few trucks and include a CIP value once improvement is observed in the digesters
- Accepting TWAS can cause more foaming, and was noted as a potential concern

Note: only motors were replaced on TWAS pumps

Optimized TWAS Addition for Max FOG Acceptance – MM



Notes:

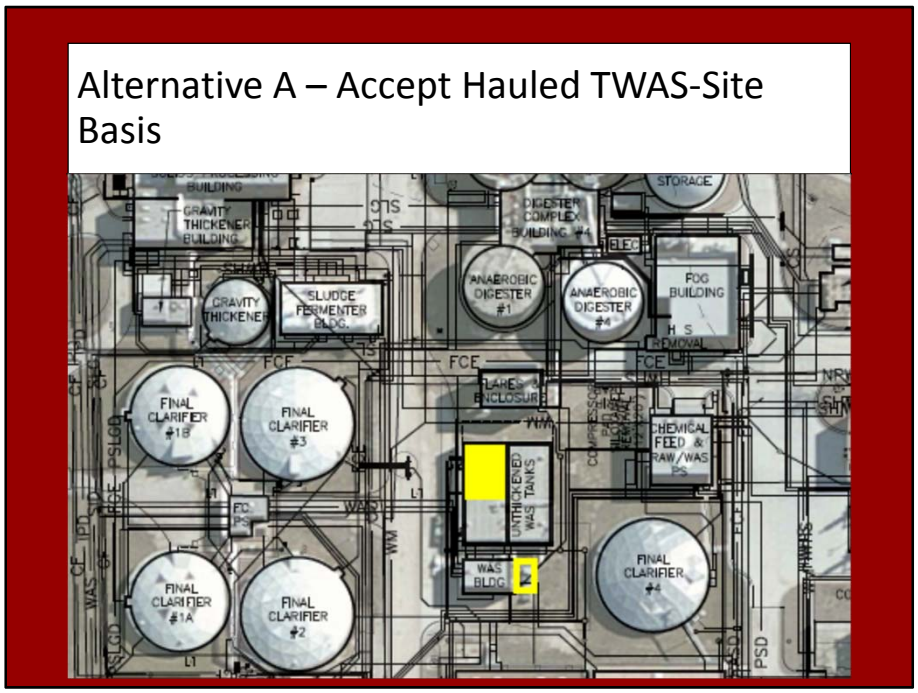
- Graph is based on current MM (not 12.0 mgd nor higher assumption for plant-generated TWAS)
- With Bottom Line numbers and all digesters in service, “peak” of curve could be pushed to 11,000 gpd of HS FOG with 50,000 gpd of TWAS.
- Only 29,000 gpd of trucked TWAS is projected to be currently available from BRM and NCAC (green vertical line added to graph to identify that limitation)
- Up to 56,000 gpd of trucked TWAS is projected to be available in the future if BRM and NCAC produce at their max rated capacity
- Accepting trucked TWAS increases the capacity for FOG until other loading criteria fail.

Alternative A – Accept Hauled TWAS-Observations

- Hauled TWAS to DLSMB can enhance capacity for FOG by as much as 50%
- Quantity of hauled TWAS that could be accepted could range from all currently hauled TWAS (29,000 gpd) up to 47,000 gpd.
- Diverting TWAS from Nelson reduces capacity of proposed FOG receiving there

Alternative A – Accept Hauled TWAS-Cost Basis

- Costs assume re-purposing half of one of the existing UWAS tanks to be TWAS unloading/EQ. Keeps 450,000 gal for UWAS (so two basins, one @ 300,000 gallons and one @ 150,000 gallons) and subdivides the other 150,000 gallon basin into two 75,000 gallon hauled TWAS storage basins. Provides 3-5 days of equalization.
- Assumes heavy duty mechanical mixers in the hauled TWAS storage for mixing solids that average 4% but could range higher.
- We would need to build a new digester feed pump station to feed the hauled TWAS to the digesters.
- Truck unloading along the north wall of the east UWAS storage basin, exists. Complete gravity unloading may not be possible when tank is completely full, so pneumatic push-off could sometimes be required.



Note: Look at variation of using existing TWAS pit as transfer wetwell/pumping to send both off-site and plant generated TWAS to TWAS storage. Would accomplish blending of plant generated and off-site generated prior to introduction into digesters and equalization of both streams.

Alternative A Capital Cost Estimate

	TWAS Unloading, Equalization and Feed
Total Capital Cost:	$ 1,500,000

Costs that may need to be added by adjusting Alternative A to include pit may include:

- Additional site piping to transfer TWAS from existing pit to converted basins for equalization/blending.

Alternative B – Convert Secondary to Primary and add separate Digested Sludge Storage

- Would require additional tankage/footprint
- Quantity of Digested Sludge that could be leaving digestion could range from:
  - Low of 86,000 gpd (DLSMB + FOG) MM
  - up to 139,000 gpd (DLSMB + TWAS + FOG) MM

Alternative B – Convert Secondary to Primary and add Digested Sludge storage-Cost Basis

- Desired HRT for post-digestion storage for Nelson evaluations was 3 days, which would require volume of 258,000 gal up to 417,000 gal.
- With dewatering capacity and redundancy at DLSMB, reduction of storage to one day could be feasible.
- Costs based on rectangular tank near sludge processing, volume 139,000 gal
- Costs assume replacement of secondary digester cover with fixed cover and new floating cover on post-digestion storage. Significant piping modifications to feed Digester 2 as a primary.
- Assumes jet mixing in the DS storage for mixing solids that average 2-3%.
- We would need to build new dewatering feed pumps and piping.

Notes:
Assumed footprint for 417,000 gal (55,748 cu.ft) is 24 ft deep, 55’ dia. Assumed footprint for 139,000 gal (18,583 cu ft) is 42x18 x25 ft deep.

Alternative B – Convert Secondary to Primary and add Digested Sludge storage-Site Basis

Note:

- Could consider moving rectangular tank to right, can cut off road access, can be larger if necessary
- However, preference would be to build tank at storage bubble site, put half bubble on top of additional storage. JCW indicated preference for membrane. This increases distance from storage to BFPs, which is a concern with struvite issue. Must address transfer from digesters to storage to BFPs.
- To utilize storage bubble footprint, existing power feeder would need to be relocated.
- JCW raised question of if Building 4 (Digester Complex) is upgraded, do we need to look at new electrical rooms?

Alternative B – Capital Cost Estimate

	Capital Cost Estimate
Convert Digester 2 to Primary Digester	$1,200,000
Construct New Post-Digestion Storage	$2,200,000
Total Capital Cost:	**$ 3,400,000**

Note: will need to be reevaluated to construct new tank at bubble location

Alternative A and B Combined Total Cost

	Capital Cost Estimate
A-TWAS Unloading and Equalization	$ 1,500,000
B-Convert Digester 2 to primary and add new Post-Digestion Storage	$ 3,400,000
Total Capital Cost:	**$ 4,900,000**

Preferred Middle Basin Improvements

- Open Discussion

Note:

- Current FOG receiving at DLSMB is 18000 gpd, which is getting close on SRTs, running on ragged edge of volatility and alkalinity in all digesters. For the short term, this will continue.
- For long term digestion at both DLSMB and NC - split FOG and TWAS to both treatment facilities
- Long term UWAS thickening plan assumes replacing centrifuges within 5 yr CIP: plan to rehab once more then replace in a few (~3) years

Review of Nelson FOG Acceptance and TWAS Receiving Recommendations

Note:

- Reminded of idea to have FOG tipping outside of gate with heated sludge stream to bring to digesters
- Another TWAS unloading connection to Dig 4 is being added right now.
- After Phase 1A is implemented, Dig 4 will be post-digestion storage, so hauled TWAS must be introduced before digestion (need to unload and get hauled TWAS into blend tanks). Will develop cost estimate for interim hauled TWAS unloading into unused old, small sludge storage tank with new pumps to blend tanks. Will add that cost to the Phase 1A budget.

Preliminary Phasing Overview

Phase 1					
1A			**1B**		
Rehab Dig 3 and ex. Sludge Storage Tanks	$5.6M		Rehab Dig 4 and Dig 1&2 (interim sludge storage, demo'd in Phase 2)	Additional $6.4M	
Nelson Current TWAS FOG	19,500 lbs 13,000 lbs 0 lbs	100% 50% (100% of current) 0%	Nelson Current TWAS FOG	19,500 lbs 26,000 lbs 11,900 lbs	100% 100% 36%
Redundancy: - Dig 4 available as storage if Dig 3 is unavailable, no digestion redundancy - Landfill backup required			Redundancy: - If one digester is unavailable, same restraints as phase 1A - Landfill backup required		
Cumulative Phase 1 Cost: $12M					

29

Preliminary Phasing Overview

Phase 2		
Build Dig 5, demo Dig 1&2, build FOG handling station, incorporate cogeneration	$27.9M	
Nelson BNR TWAS FOG	44,200 lbs 26,000 lbs 13,600 lbs	100% 100% 41%
Redundancy: - If one digester is out of service, can only accept 4,000 lbs of FOG - Landfill backup required		
Cumulative Cost: $39.9M		

Phase 3		
Build Dig 6	$12.3M	
Nelson BNR TWAS FOG	44,200 lbs 26,000 lbs 13,600 lbs	100% 100% 41%
Redundancy: - Redundant digestion capabilities - Does not require landfilling as a backup		
Cumulative Cost: $52.2M		

Key Conclusions from Workshop No. 2

- Resume digestion at Nelson with minimal initial redundancy
- Long term plan is 4 digesters in “cloverleaf” footprint
- Receiving facilities for TWAS and FOG preferred in initial phase
- Gas utilization (beyond heating digesters) delayed until a later phase

31

Note:

- TWAS receiving is required in initial phase (1A), but FOG receiving station will not be in Phase 1A.

Key Conclusions from Workshop No. 3

- One digester can handle current Nelson-generated loads
- One digester can also handle some hauled TWAS, up to the quantities from BRM and NCAC in 2015/2016 timeframe
- One digester cannot handle the current Nelson-generated loads plus the projected hauled TWAS with BRM and NCAC at their capacities

From Workshop No. 3-Business Case for Phase 1

- Primary Driver is reliability of landfill option
  - As documented in Executive Summary, landfill option is tenuous due to continued concerns about odors at landfill, and the decision to accept biosolids there rests with the landfill and city, not JCW
  - Under Phase 1, Landfilling becomes Plan B, since if one digester is out of service, Class B is not achievable
  - As documented in Executive Summary, there are social and environmental benefits to Phase 1:
    - Reduced Odors at Landfill and along haul route
    - Beneficial Reuse of biosolids
  - JCW Staff has not been able to find another landfill to accept sludge, so cost is currently unknown, i.e., Lawrence Hamm Quarry, Courtney Ridge
  - At this time, there is no known Plan B for landfilling at the Johnson County Landfill

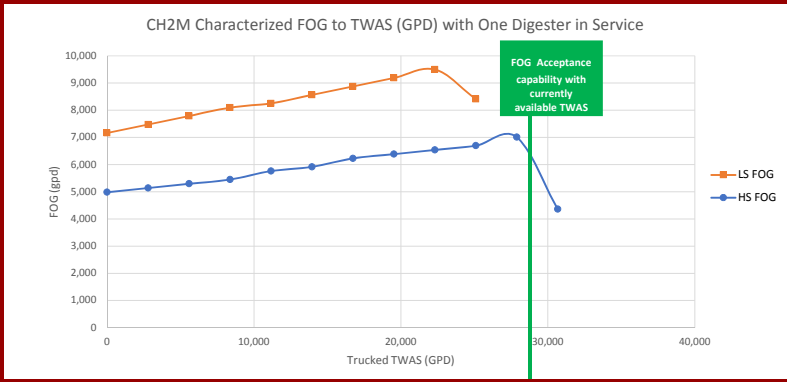
From Workshop No. 3-Business case for adding FOG facilities at Nelson

- Provides redundancy for FOG acceptance when Middle Basin can not accept FOG
- B & V current recommendation is 6,000 gpd industrial plus 4,000 gpd unconcentrated restaurant FOG, or about 1,500 gpd restaurant FOG if concentrated
- JCW plans to operate at 18,000 gpd, which is close to estimate for current JC FOG of 6,000 industrial and 13,000 gpd FOG
- Nelson can accept 31% of current JC FOG (subject to re-evaluation with new data)
- A key driver for FOG acceptance at Nelson is redundancy for FOG acceptance at Middle Basin, decision to operate in unstable range makes this more critical
- Another driver is Nelson FOG facilities are nearly self-funded, tipping fee revenue will likely exceed O & M and P & I costs

Re-evaluation of TWAS Receiving at Nelson

- At 9,000-12,000 gpd recommended FOG acceptance at Middle Basin, up to 44,000-47,000 gpd TWAS can be accepted there
- However, only 29,000 gpd hauled TWAS currently available
- Nelson budget includes TWAS unloading facilities with the budget for FOG receiving facilities
- TWAS receiving/unloading at both Nelson and Middle Basin offers redundancy and backup.

Recommended Practices and Facilities for TWAS Acceptance at Nelson



Preferred Facilities for TWAS Acceptance at Nelson

- Open Discussion

Note: During the short-term while 18,000 gpd of FOG is going to MB, expect all hauled TWAS to go to Nelson. Provide TWAS unloading as noted on slide 28 and incorporate into Nelson Phase 1A. .

Note:

- Plan for Nelson Phase 1A, DLSMB bicarbonate alkalinity addition, and DLSMB centrifuge rehab in 5 year CIP.
- Need long term improvement plan to get TWAS storage/equalization/blending at MB, and Nelson Phase 1B/Phase 2 digestion improvements implemented. Nelson nutrient improvements may incorporate up through digestion Phase 2.

Scope of Work

- Evaluate FOG Acceptance Policy Development Options:
  - Total Metro Area
  - Kansas Only
  - Johnson County Only
  - Volume Limits
  - Organic Loading Limits
- Evaluate possible NC/DLSMB WWTP FOG volume and organic loading split.
- Develop approach for FOG deliveries at two facilities
- FOG Tipping Fee and Practices Survey (additional item)

From Workshop 1 – Projected 2030 Quantity from all FOG sources

Parameter	Johnson Co. 2030 Grease Interceptors	Johnson Co. Industrial FOG	Total Johnson Co. only FOG Sources	Metro Area 2030 Grease Interceptors	Metro Area 2030 plus Johnson Co. Industrial FOG
Population Served	730,000	NA	730,000	2,300,000	2,300,000
Lbs TS/person/year	2.8	NA		2.8	
TS ppd	5,600	10,000	15,600	17,600	27,600
Concentration TS %	4 - 7.5	20		4 - 7.5	
AA gpd [1]	16,800 - 9,000	6,000	22,800 – 15,000	52,900 – 28,200	58,900 – 34,200

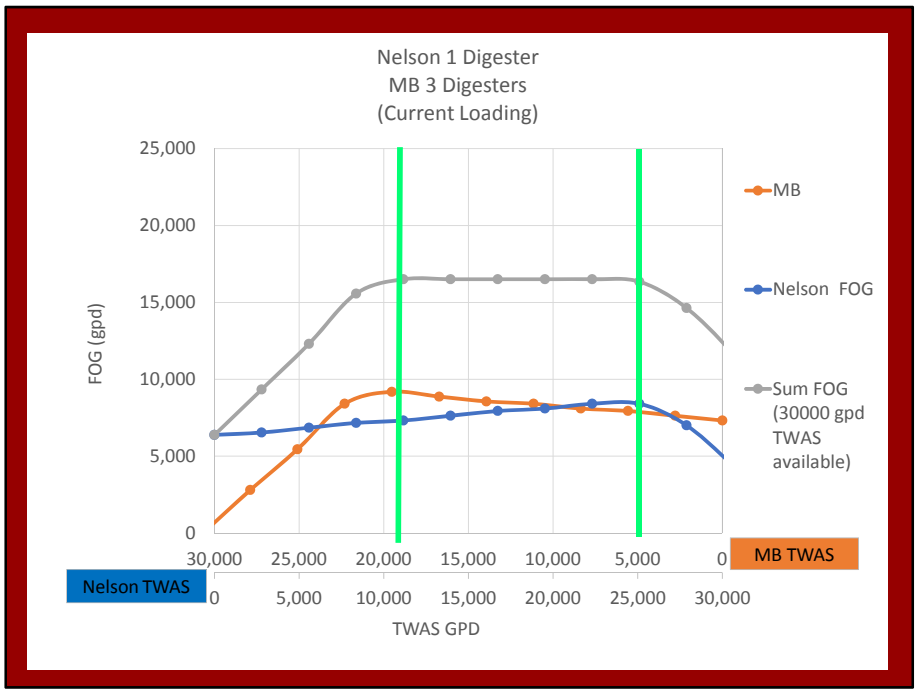
(1) Calendar average, not working days

Potential NC/DLSMB WWTF FOG volume and organic loading split

- Current (if FOG is HS)
  - Middle Basin – 8,000 gpd (and all current TWAS)
  - Nelson – 5,000 gpd (none of current TWAS)
  - Total 13,000 gpd FOG acceptance (HS)

- Current (if FOG is LS)
  - Middle Basin – 10,000 gpd (and all current TWAS)
  - Nelson – 7,000 gpd (none of current TWAS)
  - Total 17,000 gpd FOG acceptance (LS)

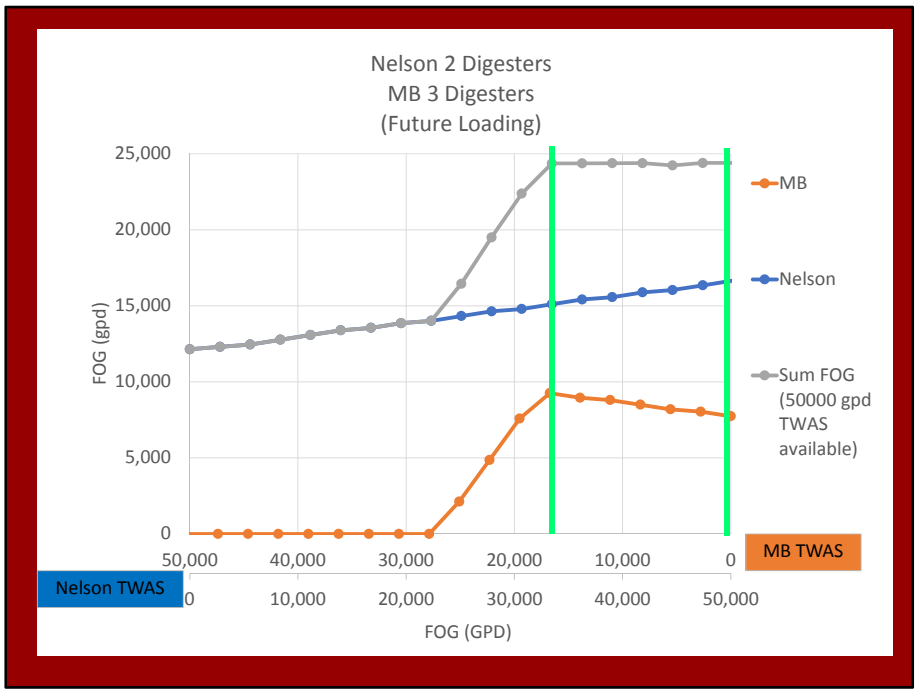
Note: A wide range of possible scenarios exist. Additional potential scenarios will be summarized in report.



This slide was added for the March 20, 2018 Follow-up Briefing
Current Loading:

Nelson Current Onsite Production
Middle Basin Current Onsite Production
TWAS Current

Optimal TWAS ranges shown in green above (Assumes FOG receiving capabilities at Nelson)
Based on a FOG COD concentration of 173,000 mg/L (a midpoint between high strength and low strength FOG), an optimal TWAS distribution will allow a maximum of 16,500 gpd of FOG between the two facilities
This graph assumes three active digesters at MB (previously calculated with an active volume in the secondary digester)



This slide was added for the March 20, 2018 Follow-up Briefing

Future Loading:

Nelson BNR Onsite Production

Middle Basin Future Onsite Production (12 MGD)

TWAS Future (50000 gpd, current rated capacity of BRM1 and NCAC)

Optimal TWAS ranges shown in green above (Assumes FOG receiving capabilities at Nelson)

Based on a FOG COD concentration of 173,000 mg/L (a midpoint between high strength and low strength FOG), an optimal TWAS distribution will allow a maximum of 24400 gpd of FOG between the two facilities

This graph assumes three active digesters at MB (previously calculated with an active volume in the secondary digester)

If the existing secondary digester at MB were converted to a primary, 24400 gpd of FOG could be accepted for all TWAS scenarios shown

FOG Tipping Fee and Practices Survey - Regional

	Cost Per Gallon	Sampling	Concentration based Fee?	Notes
Des Moines, IA	$0.02-$0.21	Random	N	Fee is based on hauling location (headworks/ digesters) and if inside or outside of service area
West Lafayette, IN	$0.25	N	N	
Topeka, KS	$0.08	Rarely	N	Staggered deliveries, and haulers are required to deliver on a schedule
Kansas City, KS	$0.10		N	Billed per truckload, assuming 75% full tank capacity
Springfield, MO	$0.06	N	N	
LES	$0.10+		N	Unable to obtain specific costs

Note:

- Regional slightly higher, room to increase from current $0.07/gal tipping fees if desired
- Unconfirmed Defenbaugh rates are rumored at $0.40/gal
- Verbal from ZW Tech in past was that they couldn't breakeven below $0.14/gal

FOG Tipping Fee and Practices Survey

	Cost Per Gallon	Sampling	Concentration based Fee?	Notes
Buford, GA	$0.03	Y ($0.07/gal for HS)	N ("One-off")	0.05 to 0.07 for HSW depending on VSS/TSS ratio
New Haven, Connecticut	$0.13	N	N/A	The fees for these facilities were determined in 2000, may have changed due to inflation. However, the fees were calculated based on a 20 year payback period
Pinellas County, Florida	$0.12	N/A	N/A	
Calgary, Alberta	$0.07	N	N	Service charge of $20.23 USD every 30 days

Recommended Tipping Fees and Practices

- Tipping Fees
  - Base fees on COD concentration as well as volume
- Practices
  - Collect a sample from all deliveries
  - Perform Tests on limited number of samples, say 10%
  - Direct haulers with higher strength FOG to Middle Basin
  - Others?
- FOG Equalization
- Hauler priority

Notes:

- Sampling of all loads with random testing is recommended. Policy should address where to sample/who collects and identifies sample, etc.
- Tiered rate structure was suggested:
  - Inside Johnson Co. , "Low Strength" range
  - Inside Johnson Co., "High Strength" range
  - Outside Johnson Co., "Low Strength" range
  - Outside Johnson Co., "High Strength" range
- Policy needs to be established for how to accept, currently first come first serve. However, registering haulers and assigning them into the tier structure may cut down on some infrequent contributors. Registering could include registering for up to a max quantity as part of the process.
- Policy should address potential political concerns about prioritizing Johnson Co. FOG first since FOG improvements were paid for by JCW ratepayers. Political preference for not adversely affecting business economic viability within Johnson Co.
- JCW should consider conducting a formal FOG acceptance fee evaluation, including cost of service and market conditions considerations.

Recap of Nelson Study Objectives

Alternatives (MM)	Nelson Phase 1A $5.6M	Nelson Phase 1B $6.4M	Nelson Phase 2 $27.9M	Nelson Phase 3 $12.3M
Capacity to treat plant generated and hauled solids	Capacity to treat Current Onsite and up to 33000 gpd hauled TWAS			
Capacity to treat plant generated and hauled solids with redundancy		If one digester out of service, no redundancy available		
Alternative available to landfill				
Alternative available to landfill with redundancy				
FOG Redundancy/ Flexibility				

This slide was added for the March 20, 2018 Follow-up Briefing

Note:

- Need a business plan that justifies policy
- Need a manager to run FOG program (policy and scheduling)?

Closing and Next Steps

- Next Steps
  - Develop Minutes of Workshop No. 4
  - Pre-Design Report and Executive Summary

49

And the Oscar for the Best Actress in a Supporting Role Goes To….?

THANK-YOU

- Questions?
- Concerns?
- Was this meeting of value?
- Other feedback?

51