CHAPTER 8

SOLIDS PROCESSING ALTERNATIVES

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Solids that are produced as part of the wastewater treatment process must be treated and reused or disposed of in an environmentally and economically acceptable manner. Solids treatment includes reduction of the water content, stabilization of volatile compounds, reduction of pathogens, and storage during wet weather. Following these steps, the biosolids are applied on agricultural land. Alternatives for solids processing are evaluated in this chapter.

The Department of Environmental Quality encourages the beneficial reuse of biosolids through land application. While incineration has been practiced, air quality concerns and cost have eliminated most of these facilities. Some communities dispose of dewatered solids in landfills, but the beneficial attributes of the solids as a soil amendment are lost in this approach. In addition, the ability to reliably dispose of the sludge is subject to the discretion of the landfill operator. Some successful sludge management programs utilize landfill disposal as a wet-weather or emergency disposal strategy. Lebanon currently applies solids to agricultural land in a manner consistent with regulatory requirements for beneficial reuse.

EXISTING SYSTEM

Solids at the existing plant consist of the waste activated sludge that is thickened with a gravity belt thickener and stabilized in the aerobic digesters. Lime stabilization has been employed occasionally when the level of volatile solids reduction has not met regulatory requirements. Digested solids are then trucked to farmers' fields when weather conditions permit application. DEQ's policies on land application are becoming more restrictive with respect to approval of fields for wet season application and communities are being forced to provide some winter storage.

Estimated solids production rates are necessary to evaluate process options. Under current loading conditions, the plant generates approximately 5,000 gallons of sludge per day. Solids production projections are summarized in Table 8-1.

Table 8-1. Sludge Production Projections

Year	Sludge Production, lbs/day	Sludge Production, gal/day[a]
1999	2,300	5,000
2010	2,750	6,000
2020	3,250	7,100
2023	3,400	7,500

[a]Based on average thickened waste activated sludge pumped to digester at 5.5 percent solids.

The existing solids processing units include the gravity belt thickener and the aerobic digesters. The gravity belt thickener has more than adequate capacity for the projected solids quantities. At a thickened sludge concentration of 5.5 percent, the large aerobic digester has a capacity to stabilize approximately 3,000 pounds per day of sludge. However, operations personnel report that the existing aerators do not provide adequate mixing coverage, which can impair treatment.

The smaller aerobic digester has a volume of about half that of the larger digester and could stabilize a maximum of 1,500 pounds per day of sludge if it were operated continuously at its maximum liquid level. Its actual capacity is reduced proportionately when some of its volume is unused.

With the existing system, limited storage is available during extended wet periods. To accommodate this lack of storage, operators use the large aerobic digester to store solids by lowering the operating level of the digester and filling it when land application is not allowed. The small aerobic digester is operated in a similar manner and is also used for lime stabilization.

BIOSOLIDS QUALITY

Biosolids produced at the Lebanon Wastewater Treatment Plant meet the Environmental Protection Agency's (EPA) requirements for land application. Table 8-2 shows the general biosolids characteristics, while Table 8-3 summarizes the concentration of heavy metals detected in the biosolids. As shown, not a single sample has exceeded the allowable limit for any of the metals, even for exceptional quality biosolids.

Table 8-2. Biosolids Characteristics

Parameter	Minimum	Average	Maximum
Total Solids	1.80	2.27	3.10
Volatile Solids	1.09	1.38	1.80
VS% / TS%	0.51	0.61	0.72
Ammonia Nitrogen	0.60	0.51	1.09
Nitrate Nitrogen	0.01	0.20	0.72
Total Kj. Nitrogen	1.90	5.02	6.11
Phosphorus	0.65	1.70	2.81
Potassium	0.50	0.86	1.20
pH	4.90	6.90	11.4

Table 8-3. Biosolids Quality – Metals

Parameter	Measured Concentration, mg/kg			Standard, mg/kg	
	Minimum	Average	Maximum	Limit	Exceptional Quality
Arsenic	3.0	7.3	28.0	75	41
Cadmium	0.2	4.9	30.6	85	39
Chromium	10.1	18.1	30.6	3,000	1,200
Copper	143.0	301.0	759.0	4,300	1,500
Lead	2.0	74.0	277.0	840	300
Mercury	0.3	2.2	11.1	57	17
Molybdenum	0.5	4.7	11.2	75	18
Nickel	0.7	13.1	29.5	420	420
Selenium	3.9	8.4	26.0	100	36
Zinc	367.0	670.0	1,430.0	7,500	2,800

SOLIDS MANAGEMENT ALTERNATIVES

There are numerous processes available for solids management which, in combination, are capable of providing effective solids treatment prior to disposal. Figure 8-1 illustrates a full range of alternatives that are available to the City. In addition to aerobic digestion, anaerobic digestion or lime stabilization could be used to meet the regulatory requirements for pathogen and vector attraction reduction.

Based on a review of system capacity and performance, and the regulatory conditions that govern the solids management program, alternatives for storing biosolids during the wet season need to be considered. With adequate storage facilities available, the existing system can process the projected volumes of biosolids for the duration of the planning period. Storage of liquid or solids is feasible and both are considered in the subsequent discussions.

Treatment Level

As shown in Figure 8-1, many alternatives are available for processing solids to achieve either Class A or Class B biosolids. Class A biosolids can be distributed with few restrictions because a high level of pathogen reduction has been achieved.

The processes shown for production of Class A biosolids have both a significant initial capital cost and ongoing operation and maintenance costs. Communities in Oregon that produce Class A biosolids have generally achieved the requirements as an indirect result of the primary processes used in their solids management program. For example, McMinnville uses auto heated thermophilic aerobic digestion as the primary process for solids stabilization and thus produces Class A biosolids. Medford stores digested solids in lagoons and then air dries the solids to a very dry state that reduces pathogens to Class A levels. The City of Newport utilizes a lime stabilization process to produce a Class A biosolids product.

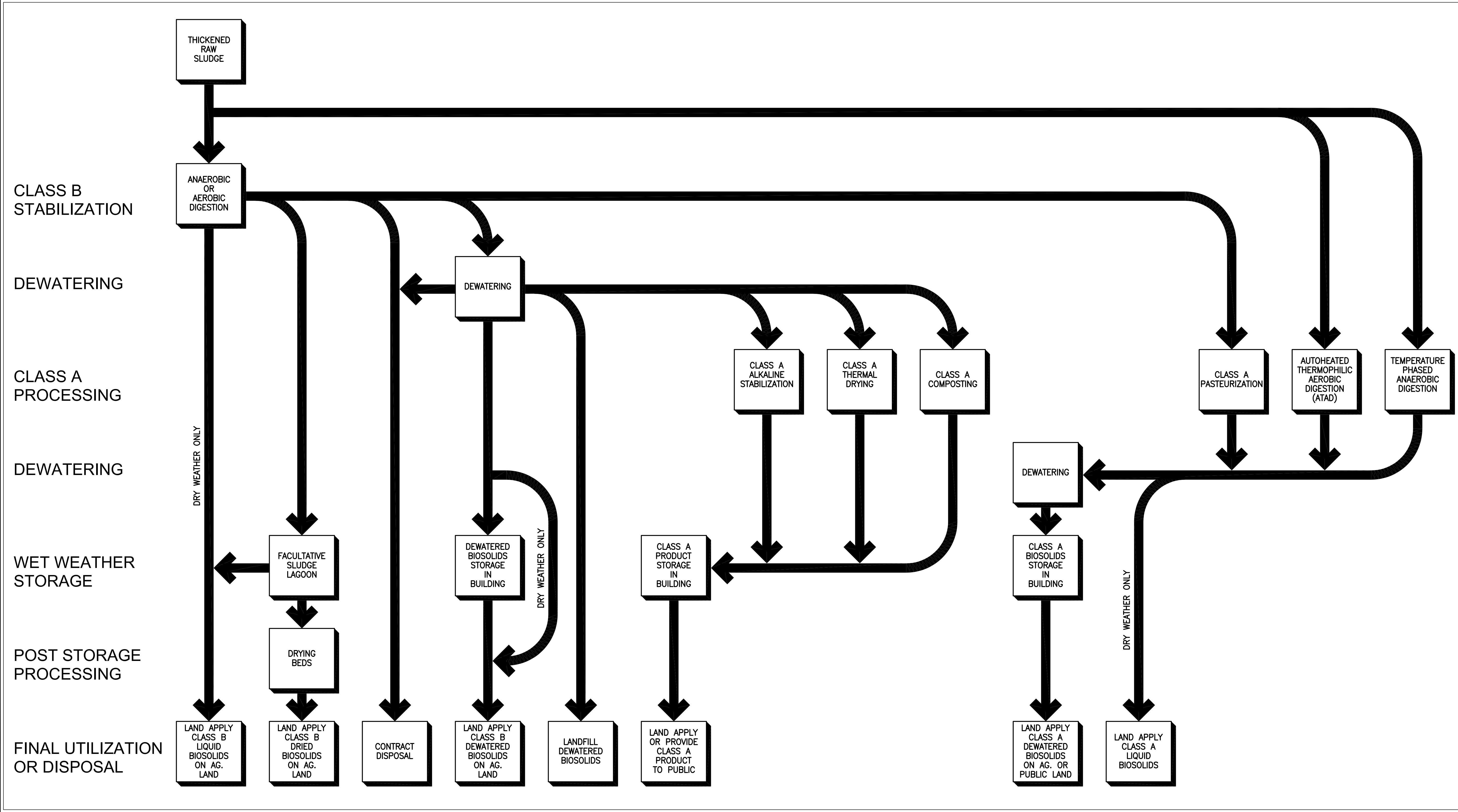

FIGURE 8-1

SOLIDS MANAGEMENT ALTERNATIVES

WEST YOST & ASSOCIATES

516-00-02-FIG_8-1 4MV-FULL.PC2 4-1-04 VLF

The Lebanon plant currently produces Class B biosolids which are acceptable for more routine agricultural reuse applications. Most of the farmland in the Lebanon area is used for crops for which Class B biosolids can be applied.

Solids management program alternatives for producing Class B biosolids are evaluated below.

Alternative 1—Lagoon Storage

If adequate land is available, facultative sludge lagoons can be one of the most cost effective storage systems available. A schematic of a solids management system that employs facultative sludge lagoons is shown in Figure 8-2. These lagoons are sized based on volatile solids loading and are operated with a water cap above the solids to provide an aerobic zone above the anaerobic solids.

Facultative lagoons are typically 12-to-15-foot-deep earthen ponds with synthetic liners and piping that allows for return of the supernatant to the treatment plant for processing. At a minimum, facultative lagoons are designed to provide six months of solids storage. However, additional storage will improve operational flexibility and allow for a very efficient land application program. Solids are typically removed from the lagoon with a dredge.

Facultative sludge lagoons are normally used in treatment plants equipped with anaerobic digesters. In fact, the *Process Design Manual for Sludge Treatment and Disposal* (EPA, 1979) states that facultative sludge lagoons should only be used following anaerobic digestion to eliminate the risk of odors. However, experience in Oregon at the North Bend and Cave Junction treatment plants has shown that it is possible to pair facultative sludge lagoons with aerobic digesters. In North Bend, the storage lagoon is aerated to ensure that aerobic conditions are sustained in the water cap. In Cave Junction, the facultative sludge lagoon was conservatively sized to keep volatile solids loading rates lower than textbook values. While the sludge lagoon at the Cave Junction treatment plant is equipped with a surface aerator, operations personnel report that it has never been used.

The inconsistencies between the EPA design manual and recent Oregon experience have prompted us to include two variations to this alternative. For both alternatives, it is anticipated that the City's existing lagoons would be upgraded to serve as sludge lagoons. Improvements would include new levees to create two lagoons; a dredge for sludge removal; piping improvements; surface aerators to ensure an aerobic upper water level; and a synthetic membrane liner. Facultative lagoons offer the additional benefits of extended sludge storage and further volatile solids reduction.

Alternative 1A—Aerobic Digesters and Facultative Sludge Lagoons. The aerobic digesters would be fitted with new aeration equipment as required, but essentially retained in their current state. Operated in conjunction with the gravity belt thickener, the two digesters would provide a combined solids retention time of over 70 days at projected year 2024 maximum month loading conditions. To reduce the potential for odors, the facultative sludge lagoons would be sized for a maximum month volatile solids loading rate of 10 pounds per day per 1,000 square feet of surface area—half the normal design loading rate. The two 3-acre lagoons would provide over 10 year's worth of sludge storage.

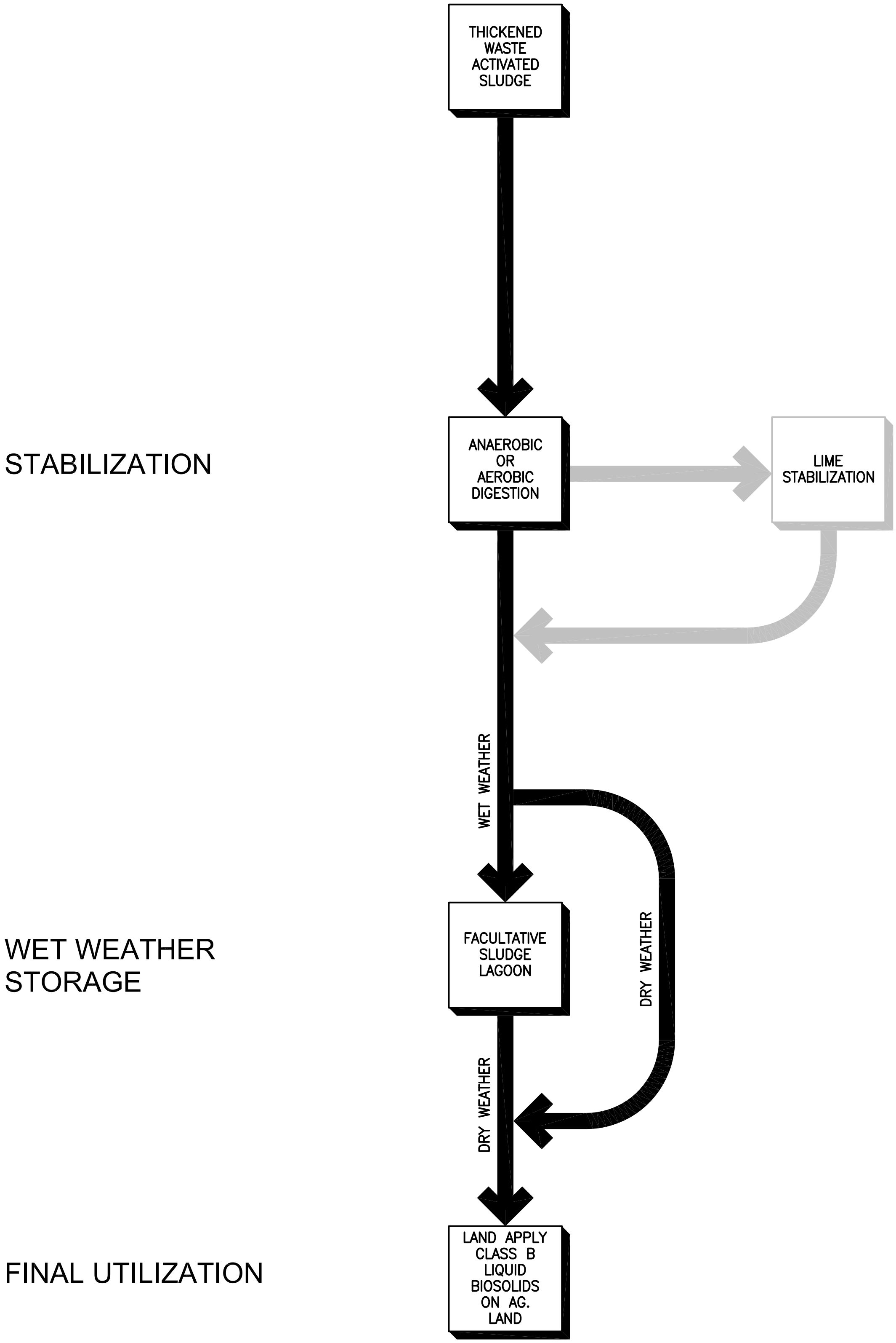

FIGURE 8-2

ALTERNATIVE 1
AEROBIC DIGESTION AND LAGOON STORAGE

WEST YOST & ASSOCIATES

516-00-02-FIG_8-2 4MV-FULL.PC2 4-1-04 VLF

Alternative 1B—Anaerobic Digester and Facultative Sludge Lagoons. The City's smaller aerobic digester is a converted anaerobic digester. Reconfigured to an anaerobic digester and operated in conjunction with the gravity belt thickener, it would provide a solids retention time of 22 days at projected year 2024 maximum month loading conditions. Conversion to anaerobic digestion would require significant modifications, including:

- A new cover.
- Sludge mixing system.
- Sludge heating system, including boiler, heat exchanger, and recirculation pumps.
- Gas handling system, including piping, pressure relief systems, dryer, safety systems, and flare.
- A new digester building.

While significantly more complex than aerobic digesters, anaerobic digesters offer the primary advantages of improved volatile solids reduction and lower energy use. In fact, some of the energy gained by burning sludge gas in the boiler can be utilized for building heating during the winter months. Larger communities, such as Portland, Eugene, and Medford, have found that they can realize a net income by creating electrical power as part of a cogeneration system.

With anaerobically digested sludge, the facultative sludge lagoons could be sized at the conventional loading rate of 20 pounds per day of volatile solids per 1,000 square feet of surface area, resulting in two lagoons with a nominal surface area of 1.5 acres each.

Design data for these alternatives is provided in Table 8-4, while cost estimates are shown in Table 8-5. Operation and maintenance costs are shown in Table 8-6.

Table 8-4. Alternative 1 Design Criteria

Description	Alternative 1A		Alternative 1B	
	Existing	2024	Existing	2024
Aerobic Digester				
Number	1	1	1	--
Diameter, ft	95	95	95	--
Depth, ft	10	10	10	--
Total volume, 1,000 ft^3	71	71	71	--
Mechanical aerators				
Number	3	4	3	--
HP	20	20	20	--
Sludge Holding Tank/Aerobic Digester System				
Sludge holding tank				
Number	1	1	1	--
Diameter, ft	45	45	45	--
Depth, ft	20	20	20	--
Volume, 1,000 ft^3	35	35	35	--

Description	Alternative 1A		Alternative 1B	
	Existing	2024	Existing	2024
Holding tank sludge pump				
Number	1	1	1	--
Type	Plunger	Plunger	Plunger	--
HP	2	2	2	--
Capacity, each, gpm	75	75	75	--
Head, ft	25	25	25	--
Aeration equipment – blower				
Type	Positive displacement	Positive displacement	Positive displacement	--
HP	60	60	60	--
Capacity, scfm	700	700	700	--
Pressure, psi	12	12	12	--
Diffusers				
Type	Fine bubble	Fine bubble	Fine bubble	--
Diameter, inches	9	9	9	--
Number	544	544	544	--
Anaerobic Digester (existing small aerobic digester)				
Number	--	--	--	1
Diameter, ft	--	--	--	45
Depth, ft	--	--	--	20
Volume, 1,000 ft^3	--	--	--	35
Solids retention time at maximum month load, days	--	--	--	22
Cover type	--	--	--	Fixed
Sludge heat exchanger				
Number	--	--	--	1
Type	--	--	--	Spiral
Sludge recirculation pump				
Number	--	--	--	1
Type	--	--	--	Recessed impeller
Boiler				
Number	--	--	--	1
Type	--	--	--	Hot water
Capacity, MMBTU/hour	--	--	--	1
Mixer				
Number	--	--	--	1
Type	--	--	--	Propeller
Motor horsepower	--	--	--	7.5
Lagoons				
Number	--	2	--	2
Surface area, acres, total	--	6	--	3
Maximum liquid depth, ft	--	15	--	15
Volume, 1,000 ft^3, total	--	3,300	--	1,600
Design loading, lbs VS/1,000 ft^2	--	10	--	20
Digested sludge pumps				
Number	--	2	--	2

Description	Alternative 1A		Alternative 1B	
	Existing	2024	Existing	2024
Type	--	Centrifugal	--	Centrifugal
Capacity, each, gpm	--	200	--	200
Dredge				
Number	--	1	--	1
Truck loading system				
Storage tank				
Number	--	1	--	1
Capacity, gallons	--	20,000	--	20,000
Truck loading pump				
Number	--	1	--	1
Type	--	Recessed impeller	--	Recessed impeller
Capacity, gpm	--	500	--	500
Sludge truck				
Number	--	1	--	1
Capacity, gallons	--	3,000	--	3,000

Table 8-5. Alternative 1 Capital Cost Estimate

Item	Alternative 1A $1,000	Alternative 1B $1,000
Aerobic Digester Modifications	54	--
Anaerobic Digester Conversion	--	847
Facultative Sludge Lagoons	1,500	1,267
Disposal/Land Application Equipment	80	80
Subtotal	1,634	2,194
Contingencies	327	439
Construction Cost	1,961	2,633
Engineering and Administration	392	526
Total Capital Cost	2,353	3,159

Table 8-6. Alternative 1 Annual O&M Costs

Item	Alternative 1A $1,000	Alternative 1B $1,000
Energy Cost	54	8
Chemical Cost	--	--
Labor Cost	48	55
Total	102	63

Alternative 2—Dewatered Solids Storage

By dewatering the biosolids after digestion, the volume of storage required is reduced by a factor of six. A schematic of a solids management system that employs storage of dewatered solids is shown in Figure 8-3.

Dewatered solids can be stored in a covered area similar to the existing solids storage building. Dewatering to a solids content of 16 to 20 percent or greater is required and can be accomplished either with a belt filter press or centrifuge. With the projected solids production of 3,400 pounds per day, about 1,500 cubic yards is needed to provide six months worth of storage. The existing building only provides about 100 cubic yards of storage per foot of depth; therefore, it is inadequate for the projected sludge quantities. Additional storage would have to be provided. Furthermore, the existing building would have to be upgraded to optimize the storage operation.

The dewatering alternative would require construction of a new dewatering facility including a building, belt filter press or centrifuge, related pumping systems, conveyor system to move the dewatered solids, chemical feed systems, and polymer storage. For the land application program, new field application equipment would be needed along with a front end loader to load solids at the plant site, a dump truck, tractor, manure spreader, and front-end loader at the biosolids application site.

The need for an odor control system should also be considered. At the very least, the storage facilities should be designed such that a high capacity ventilation and odor scrubbing system can be added should odors become problematic. The City of Albany successfully operates a dewatered sludge storage facility without an odor control system. However, it should be noted that Albany stores anaerobically digested sludge, which typically has a significantly lower volatile solids content than aerobically digested sludge. Costs for odor control are not included in this evaluation.

A significant advantage of this alternative is that it presents the opportunity to haul dewatered biosolids to a landfill for disposal during wet weather or emergency situations. While DEQ encourages beneficial reuse of biosolids though application on agricultural land, some communities have found that it is more economical and convenient to haul the material to landfills. Landfill operators often use the biosolids as a cover material.

This alternative also provides the flexibility to incorporate additional processes in the future to produce a Class A product. Driers and lime stabilization processes required dewatered sludge.

Table 8-7 summarizes the design criteria for the solids dewatering facility. While information and costs are presented for a belt filter press, centrifuges should be evaluated as part of the preliminary design process.

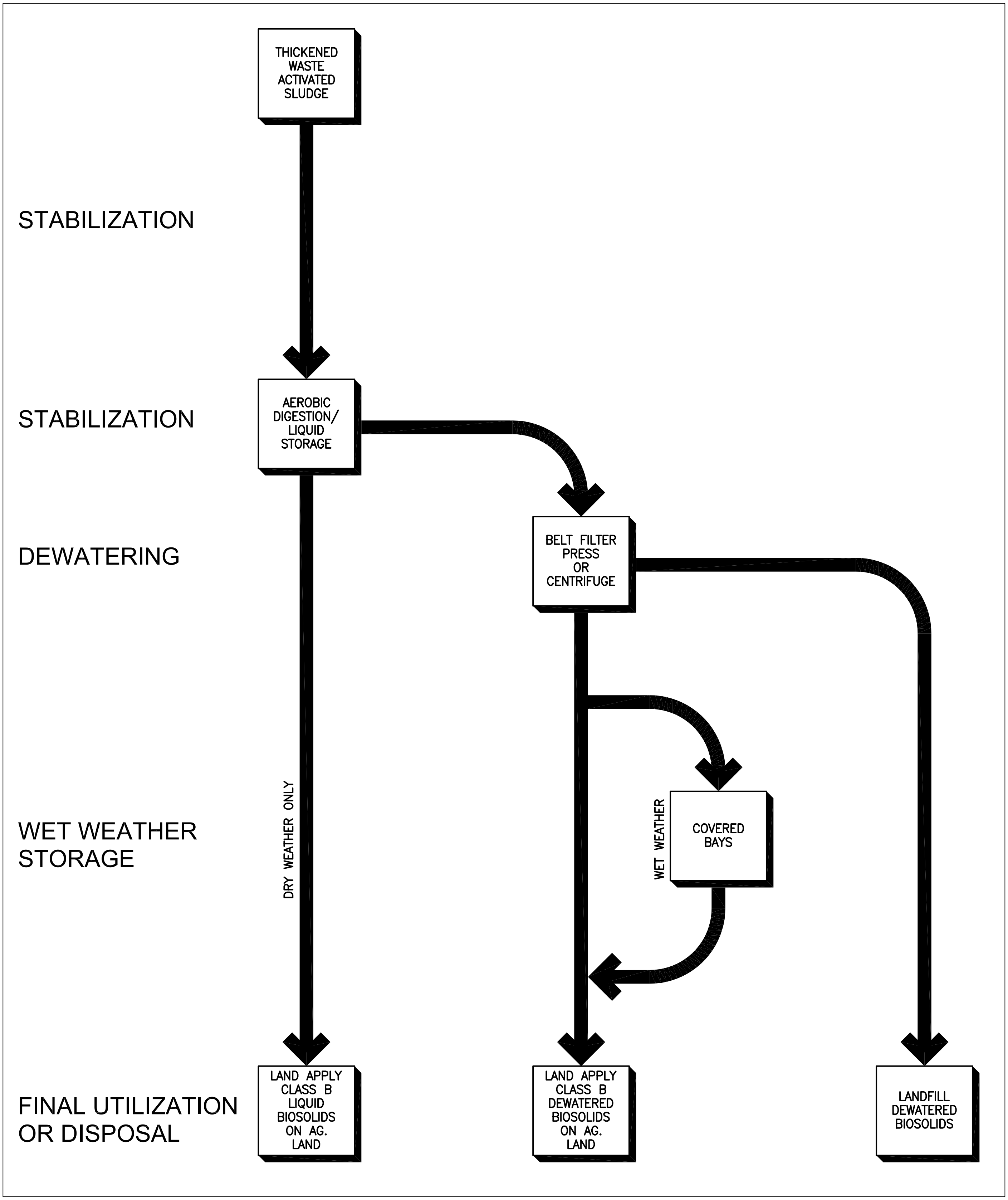

FIGURE 8-3

ALTERNATIVE 2
AEROBIC DIGESTION AND STORAGE
OF DEWATERED BIOSOLIDS

WEST YOST & ASSOCIATES

516–00–02–FIG_8–3 4MV–FULL.PC2 4–1–04 VLF

Table 8-7. Alternative 2 Design Criteria

Description	Existing	2024
Aerobic Digester		
Number	1	1
Diameter, feet	95	95
Depth, feet	10	10
Volume, 1,000 ft^3	71	71
Mechanical aerators		
Number	3	4
Motor horsepower, each	20	20
Sludge Holding Tank/Aerobic Digester System		
Sludge holding tank		
Number	1	1
Diameter, feet	45	45
Depth, feet	20	20
Volume, 1,000 ft^3	35	35
Holding tank sludge pump		
Number	1	1
Type	Plunger	Plunger
Motor horsepower	2	2
Capacity, gpm	75	75
Discharge head, feet	25	25
Aeration system		
Blower		
Type	Positive displacement	Positive displacement
Motor horsepower	60	60
Capacity, scfm	700	700
Discharge pressure, psig	12	12
Diffusers		
Type	Fine bubble membrane	Fine bubble membrane
Diameter, inches	9	9
Number	544	544
Dewatering System		
Type		Belt filter press
Number		1
Belt width, meters		1
Feed rate, gpm		30
Dewatered sludge concentration, %		18
Polymer feed system		
Number		1
Type		Liquid
Digested sludge feed pumps		
Number		2
Type		Positive displacement
Dewatered sludge conveyance system		
Number		1
Type		Belt conveyor

Description	Existing	2024
Dewatered Biosolids Storage		
Existing storage building		
Area, ft^2	2,800	
Storage depth, feet	6	
Storage volume, yd^3	600	
New storage building		
Area, ft^2		4,100
Storage depth, feet		6
Storage volume, yd^3		900
Total storage volume, yd^3	600	1,500
Land Application Equipment		
Front-end loader		
Number		2
Dewatered sludge trucks		
Number		2
Tractor		
Number		1
Manure spreader		
Number		1

The estimated cost for Alternative 2 is shown in Table 8-8. This includes the cost for the new buildings and related equipment, modifications to the storage building, and equipment required for land application of dewatered solids.

Table 8-8. Alternative 2 Capital Cost Estimate

Item	Cost, $1,000
Aerobic Digester Modifications	54
Sludge Dewatering	939
Covered Storage Building	543
Disposal/Land Application	600
Subtotal	2,136
Contingencies	427
Construction Cost	2563
Engineering and Administration	513
Total	3,076

O&M requirements for this alternative require the chemicals and labor associated with the operation of the belt filter press. Estimated O&M costs are summarized in Table 8-9.

Table 8-9. Alternative 2 Annual O&M Costs

Item	Cost, $1,000
Energy Cost	54
Chemical Cost	10
Labor Cost	100
Total	164

Alternative 3—Lime Stabilization

Lime stabilization is a treatment process that could be used to generate either Class A or Class B biosolids, depending on the specific process used. A schematic of a solids management system that uses lime stabilization is shown in Figure 8-4. In general, producing a Class A product requires higher temperatures and extended times at high pH levels. The federal Part 503 sludge regulations list the following requirements for producing a Class B product through lime stabilization:

- Add alkaline material to raise pH to 12 and maintain pH at or above 12 for 2 hours without adding more alkaline material.
- Maintain pH above 11.5 for 22 hours without adding more alkaline material.

While there are numerous process configurations that could be used to meet these requirements, commercially manufactured lime stabilization systems are available. One such system, manufactured by RDP Technologies, was used as the basis of this evaluation. It should be noted, however, that alternative systems are available and should be evaluated during the preliminary design phase if lime stabilization is ultimately selected.

The lime stabilization system evaluated below is configured to initially produce a Class B biosolids, yet be easily upgradeable so that a Class A product can be produced in the future if desired. Major components of the RDP Class B system include:

- Sludge grinders.
- Belt filter press to dewater the sludge.
- Belt filter press ancillary systems, such as polymer feed system and sludge feed pumps.
- Dewatered sludge screw conveyor.
- Lime storage silo and feed system.
- Sludge/lime mixer.
- Belt conveyor.

To upgrade to a Class A product, a pasteurization vessel would be added to the treatment train. When combined with the high pH levels created during alkaline treatment, the high temperatures provided by the pasteurization vessel would yield a Class A product.

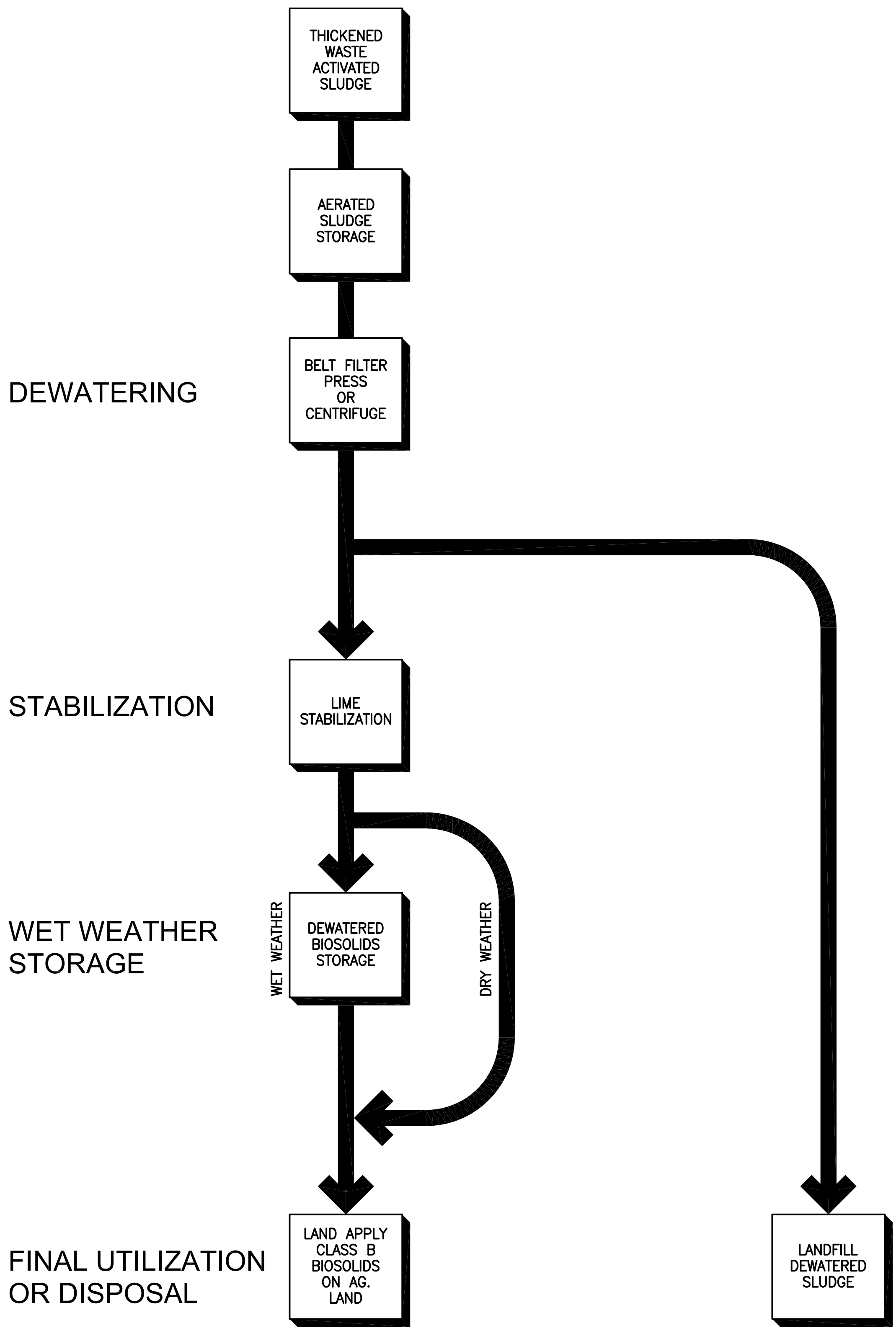

FIGURE 8-4

ALTERNATIVE 3
LIME STABILIZATION

WEST YOST & ASSOCIATES

516-00-02-FIG_8-4 4MV-FULL.PC2 4-1-04 VLF

Additional facilities would be needed beyond those listed above to ensure a complete, reliable system. While aerobic digestion would no longer be required, having the ability to store liquid sludge upstream of the belt filter press would provide significant operational flexibility. Sludge wasting from the activated sludge system could occur without regard to the status of the sludge treatment system. In addition, the storage afforded by the existing aerobic digester tanks would allow the sludge treatment system to be out of service for extended periods for maintenance or repairs without impacting liquid stream treatment processes.

Biosolids storage for the wet weather season would also be required. A storage building similar to that described in Alternative 2 would be required. Adding lime to the biosolids increases its volume, so the building size would increase slightly compared to Alternative 2. Land application equipment identical to that in Alternative 2 would also be needed.

Design data for the lime stabilization system are included as Table 8-10, while estimated construction costs are shown in Table 8-11. Anticipated O&M costs are presented in Table 8-12. It should be noted that if the City elects to produce Class A biosolids from the outset, other systems are available that should be evaluated as part of preliminary design. These include drying and pasteurization processes that, while energy intensive, do not require lime addition.

Table 8-10. Alternative 3 Design Data

Description	Existing	2024
Aerobic Digester		
Number	1	--
Diameter, feet	95	--
Depth, feet	10	--
Volume, 1000 ft^3	71	--
Mechanical aerators		
Number	3	--
Motor horsepower, each	20	--
Sludge Holding Tank/Aerobic Digester System		
Sludge holding tank		
Number	1	1
Diameter, feet	45	45
Depth, feet	20	20
Volume, 1000 ft3	35	35
Holding tank sludge pump		
Number	1	1
Type	Plunger	Plunger
Motor horsepower	2	2
Capacity, gpm	75	75
Discharge head, feet	25	25
Aeration system		
Blower		
Type	Positive displacement	Positive displacement

Description	Existing	2024
Motor horsepower	60	60
Capacity, scfm	700	700
Discharge pressure, psig	12	12
Diffusers		
Type	Fine bubble membrane	Fine bubble membrane
Diameter, inches	9	9
Number	544	544
Dewatering System		
Type	--	Belt filter press
Number	--	1
Belt width, meters	--	2
Dewatered sludge concentration, %	--	18
Sludge grinder		
Number	--	1
Capacity, gpm	--	500
Polymer feed system		
Number	--	1
Type	--	Liquid
Digested sludge feed pumps		
Number	--	2
Type	--	Positive displacement
Dewatered sludge conveyance system		
Number	--	1
Type	--	Screw conveyor
Lime Stabilization System		
Lime silo		
Number	--	1
Capacity, tons	--	30
Lime feeder		
Number	--	1
Type	--	Screw
Capacity, lbs/hour	--	1,500
Lime screw conveyor		
Number	--	1
Capacity, lbs/hour	--	500
Lime/sludge mixer		
Number	--	1
Mixing capacity, ft^3/hour	--	100
Heating capacity, kW	--	120
Class A pasteurization system	--	Not included
Belt conveyor		
Number	--	1
Capacity, tons/hour	--	40

Description	Existing	2024
Dewatered Biosolids Storage		
Existing storage building		
Area, ft^2	2,800	2,800
Storage depth, feet	6	6
Storage volume, yd^3	600	600
New storage building		
Area, ft^2	--	5,000
Storage depth, feet	--	6
Storage volume, yd^3	--	1,100
Total storage volume, yd^3	600	1,700
Land Application Equipment		
Front-end loader		
Number	--	2
Dewatered sludge trucks		
Number	--	2
Tractor		
Number	--	1
Manure spreader		
Number	--	1

Table 8-11. Alternative 3 Capital Cost Estimate

Item	Cost, $1,000
Lime Stabilization	706
Sludge Dewatering	1,067
Covered Storage Building	660
Disposal/Land Application	600
Subtotal	3,033
Contingencies	607
Construction Cost	3640
Engineering and Administration	728
Total	4,368

Table 8-12. Alternative 3 Annual O&M Costs

Item	Cost, $1,000
Energy Cost	44
Chemical Cost	27
Labor Cost	99
Total	169

EVALUATION OF ALTERNATIVES

In this section, an economic evaluation is followed by an assessment of the non-economic factors that are important for selecting the most appropriate system.

Cost Comparison

Estimated construction and O&M costs for the alternatives are included in the previous section. The economic comparison in Table 8-13 shows the present worth of each alternative. As recommended by the National Resource Conservation Service for water resources projects, the present worth calculations are based on the fiscal year 2004 discount rate of 5.625 percent and a 20-year period.

Table 8-13. Present Worth Comparison

Item	Alternative 1A $1,000	Alternative 1B $1,000	Alternative 2 $1,000	Alternative 3 $1,000
Capital Costs	2,353	3,159	3,076	4,368
Annual O&M Costs	102	63	164	169
Present Worth	3,586	3,923	5,066	6,426

Non-Economic Evaluation

Factors other than economic considerations need to be included in the assessment of the alternatives. This includes environmental impacts, anticipated performance of the facilities, and implementation issues that will need to be addressed. The key factors are discussed below.

Environmental. For Alternative 1, construction of storage at the plant site will have some environmental impacts that need to be considered. The most important impact is the potential for increasing the odor related to the operation of the plant. The facultative lagoon could emit odors if the solids loading rate exceeds the capacity of the lagoon. Solids stored at the bottom of the lagoon will be anaerobic, but will be covered with an aerobic water cap. Oxygen will be provided to the water cap by algae in the summer and surface transfer throughout the year. Examples of comparable facultative lagoon systems are located in Corvallis, Eugene, Medford, Cave Junction, North Bend, and Portland.

For Alternative 2, odor associated with the storage of dewatered solids is also a concern. Because the solids are not fully stabilized by aerobic digestion, some additional anaerobic stabilization could occur in the storage piles, resulting in odors. However, the Cities of Gresham and Albany operate comparable facilities that have not encountered significant odor problems, although they store anaerobically digested sludge.

Odors associated with Alternative 3 should be comparable to Alternative 2, with the exception that high pH levels cause volatilization of ammonia. This would be a significant concern if the sludge was anaerobically digested prior to lime addition. Another benefit of lime stabilization is that it would provide a benefit to farmers that use the product, as the high pH material could offset some of the lime that is already routinely applied to area farmland.

The facilities for all alternatives would be located well within the plant site, which minimizes exposure to the public. Water quality would be protected by installing an impermeable liner in the lagoon and covering the dewatered solids to eliminate runoff.

Performance. This criterion generally relates to how an alternative will function once it is in operation and includes operability, reliability, and flexibility.

With regard to operability, alternatives that employ less complex technologies are favored over alternatives that employ complex technologies and operational strategies. Lagoon storage is a very simple and proven technology. While dewatering is also a proven technology, it employs more complex mechanical systems. Lime stabilization requires five additional pieces of equipment compared to the dewatering alternative.

Reliability considers the likelihood that a system failure could occur. With the lagoon, inadvertent overloading could cause odors and pump failure would interrupt the plant’s ability to move solids into the lagoon. For Alternatives 2 and 3, any equipment failure will interrupt the dewatering or lime stabilization of solids. However, for both of these alternatives, a short term interruption of operation is not a significant concern because the aerobic digestion/sludge storage system provides solids storage capacity. Because Alternative 1 relies on a minimal amount of equipment, it is inherently more reliable that Alternatives 2 and 3. However, all of the alternatives include the ability to store liquid sludge for extended periods, which alleviates reliability concerns to some extent. Another issue is the system’s ability to reliably meet the treatment requirements for Class B biosolids; specifically, the 38 percent volatile solids reduction requirement. Facultative sludge lagoons provide additional solids digestion during long-term storage. Lime stabilization is exempt from the 38 percent volatile solids reduction requirement. Alternative 2 relies exclusively on the aerobic digesters to provide the necessary stabilization.

Flexibility relates to the ability of the alternatives to be modified as future changes are made to the solids management system. Compared to Alternatives 2 and 3, Alternative 1 offers little flexibility. All biosolids must be land applied as a liquid. With dewatering, the City would have the option to dispose of raw or stabilized sludge at a landfill. This is a significant advantage if land application becomes problematic. In addition, Alternatives 2 and 3 can be more easily converted to produce a Class A product. Alternative 3 in particular requires but a single, albeit expensive, additional piece of equipment to produce Class A biosolids.

Implementation. Implementation refers to the ability to receive permits for and construct the project. Some communities have had difficulty constructing facultative sludge lagoons due to unfavorable public perception. This is a serious concern which, in some cases, has resulted in City’s implementing more costly solids management programs. For Alternatives 2 and 3, the fact that these are proven processes which would be located on City-owned land alleviates other implementation concerns.

Summary

Table 8-14 summarizes the non-economic evaluation of the alternatives.

Table 8-14. Evaluation of Alternatives

Evaluation Criteria	Alternative 1A	Alternative 1B	Alternative 2	Alternative 3
Performance	Combination of aerobic digester and sludge lagoon ensures compliance with 38% VS reduction.	Anaerobic digester ensures compliance with 38% VS reduction.	Reliably complying with 38% VS reduction likely, but not ensured.	Exempt from compliance with 38% VS reduction.
Operability	Minimum equipment required. Relatively simple process.	Anaerobic digester significantly more complex than aerobic digester.	Dewatering more complex than lagoon storage.	Lime stabilization adds another treatment process and several pieces of equipment compared to Alternative 2.
Reliability	Aerobic digesters and sludge lagoons very reliable.	More complex anaerobic digester less reliable than aerobic digester.	Additional equipment increases potential for failures.	Additional equipment increases potential for failures.
Flexibility	Little flexibility. Relatively difficult to convert to Class A process.	Little flexibility. Relatively difficult to convert to Class A process.	Dewatered sludge can be hauled to landfill for disposal. Can be converted to Class A process.	Dewatered sludge can be hauled to landfill for disposal. Can be easily converted to Class A process.
Odors	Odors are a concern if lagoons are overloaded.	Odors are a concern if lagoons are overloaded; however, less so than Alternative 1A.	Odors may be a problem during transfer of solids from storage building to land application sites. Odor control for the storage building may be required.	Odors may be a problem during transfer of solids from storage building to land application sites. Odor control for the storage building may be required.
Land use compatibility	Construction of lagoons should raise no land use issues.	Construction of lagoons should raise no land use issues.	Construction of buildings plant site raises no land use issues.	Construction of buildings plant site raises no land use issues.
Implementation	May be public opposition to sludge lagoons.	May be public opposition to sludge lagoons.	Should be no significant issues related to implementation.	Should be no significant issues related to implementation.

RECOMMENDATIONS

The cost comparison favors Alternative 1, while Alternative 3 has the highest cost. However, dewatered solids storage offers significant advantages over the lagoon storage alternatives:

- Reduced risk of public opposition.
- If odors are problematic, they can be contained and treated.
- Potential to dispose of dewatered biosolids in a landfill during wet weather or if storage capacity is exceeded.
- Relatively straightforward to convert to a Class A biosolids production program such as lime stabilization in the future.

This added flexibility would allow the City to more easily adapt the solids program in response to changing regulatory requirements and public acceptance issues. For these reasons, we recommend that the City select Alternative 2—Dewatered Solids Storage.