APPENDIX G

Staff-Directed Facility Needs Assessment

Staff-Directed Facility Needs Assessment

During development of the Facilities Plan, a series of meetings were held with Plant operating and maintenance personnel. The goal of these meetings was to determine the staff perspective on Plant issues and needs relative to the County level of service objectives including the following:

- Higher risk of process failure
- Higher cost of operations and/or maintenance
- High vulnerability to capacity increase
- Operational nuisance or opportunity to increase efficiency.

Discussions covered each unit process of the Plant and the essential supporting utilities. Notes from the meetings are presented in the following sections.

Meeting 1. Primary Sedimentation and Gravity Belt Thickening

Comments on the primary sedimentation system:

1. Capacity depends on the SOR.
2. Primaries have hydraulic limitation approaching (53 mgd: primary influent channel).
3. Staff are unhappy with the countercurrent design, which has primary sludge being pumped from a well just under the inlet windows. Staff suggest that a more efficient primary thickener design is to pull laterally (from sides) to a longitudinal axis center trough.
4. Operations have achieved maximum 4 percent thickened PS by allowing blanket to build up.
5. As primary flow increases, operations lose optimum thickening; therefore, the thinking is to consider the following alternatives:
   - add capacity in the same design as present
   - add capacity using a new more efficient design
   - phase new design in and replacing, gradually, old tanks.
6. Need to consider the following impacts:
   - impact on GBTs of changes to primaries
   - impacts to digesters (thicker solids)
   - impacts to sludge pumps, scum pumps, and scum system improvements planned for 2008
   - impacts to dryer from primary/WAS proportion of sludge.
7. Scum well and concentrator will be needed: increased flow means increased scum volume.
8. Potential for greater odors from greater load/ deeper blanket held for longer time.

Comments on the solids thickening system:

1. Equipment was installed in 1994.
2. WAS thickening is at capacity now (two units); with all three units capacity would be adequate, but no redundancy:
   - hitting hydraulic limit, not “mass” limit
   - conveyor limitation: only one conveyor.

3. WAS pumping improvements scheduled for 2008 will impact GBT capacity—more flow, more hydraulic impact.
4. Operations staff prefer to have more buffer in the capacity of GBTs; not running on "ragged edge."
5. Operations staff prefers that if primary sedimentation capacity is added, then also add capacity in GBTs, digesters, down the line to the FMF.
   - One way to implement would be that new primary capacity would come with its own associated thickening equipment (new).
   - A comment was made on (seismic) vulnerability of building 280, damage from last earthquake: perhaps a parallel facility is needed.
6. Conveyor risk: 14 years running; metal fatigue is a daily risk at age of this equipment; risk of shaft snapping.
7. Could convert polymer room to GBT area in addition to continued use of existing GBT room. How would this impact cleaning? Classification of room?
8. Breezeway area (where BFPs previously located) also is available.
9. Next bottleneck is digester feed standpipe, though pumping cycle could be increased to take advantage of existing capacity—probably threefold. This needs to be confirmed.
10. Existing GBTs are in a corrosive environment; attacks metal structural integrity and instruments.
11. Larger GBT units might provide more processing capacity per unit area.

Ancillary issues discussed relative to GBTs:

1. Odor control needs.
2. HVAC/ventilation needs to control the corrosive environment.
3. Space constraints (short-term addition of fourth GBT):
   - Access to equipment needs to be considered.
   - Use parallel conveyor: remove wall between GBT room and breezeway, add new conveyor parallel to existing, place new 4th GBT in breezeway in same orientation (N-S) as existing but on other side of conveyor.
4. High-pressure air system: new unit needed for GBTs?
5. Wash water/process water system capacity.
6. Potential/provision for reclaimed water use (i.e., Class B, Plant reuse water).
7. Polymer capacity increase needed?
8. PLCs cabinets on walls of existing GBT area: not best location due to corrosion.
9. Elevator needed in building 280?

Investigation actions needed:

1. Look at capacity of existing space for GBTs (i.e., optimize) but make sure to retain adequate access for operation and maintenance.
2. Confirm structural integrity of building 280.

Meeting 2. Blowers, Aeration Basins, and Secondary Clarifiers

Comments on the aeration blowers:

1. History of existing blowers (Lampson originally, absorbed by Gardner Denver):
   - All four 500-hp blowers have been rebuilt.

    - Now have reliable motors but with questionable blowers.
    - Warranty disagreement with Lampson/Gardner Denver.
    - Four 150-hp units: three will need rebuilding, one already rebuilt.
  - Flexibility of existing system, with smaller blowers to step down/up.
  - Want to build system around biological process needs rather than around existing equipment limitations which is based on incremental (block) power steps.
  - Performance/service history of Lampson:
    - True capacity is a function of online time, need to factor in the percent of time these units are out of service for maintenance (this is a high percentage).
2. Reliability is a real issue with blowers on process failure.
3. (New) system capacity needs to consider:
   - service area expansion
   - nitrification/permit limitation consequences
   - flexibility (turn-up/turn-down) to match process.

Comments on the aeration basins:

1. WAS pumping: what affects capacity needs?
   - settleability (BOD)
   - with current upgrade, they are targeting ~ 600 gpm firm capacity (two pumps of three in service)
   - 6-inch-diameter pipe discharge; could add parallel pipe now
   - methanol to supplement cBOD is an additional impact?
2. DO control: being added in fiscal year 2008 (CIP project).
3. Impact of going to nutrient removal (not necessarily likely).
4. Aeration basin capacity: transition between adding a basin. Target aerobic detention time is 3 hours. Current peak month flow of 26.4 mgd equates to an aerobic detention time of 196 minutes, peak day flow of 36 mgd equates to 144 minutes—so already at capacity. Transition would put detention time at less than 2 hours (even with all five basins online). This might last only a day or two but it affects settleability of floc.
   - Good removal in primaries prevents overloading on solids basis. This could affect why BOD reduction is still good at ~ 3 hours HRT. But what is sensitivity if load to primaries goes up?
5. If load to system increases, need more clarifiers, or need increased volume in aeration basins. Best strategy is to take down the load in primaries, go for taking out one half of BOD in primaries.
6. Nitrogen removal might make it necessary to add aeration basin capacity even if load is taken up in primaries.
7. Ancillaries:
   - Diffusers: consider operating cost savings from flat plate diffuser.
   - Secondary clarifier vacuum collector (like the Tow-Bro units in place in clarifiers 3 and 5) is considered most efficient for blanket control, but best performance is from tanks 4 and 6. Operators prefer units 4 and 6 which are not vacuum type (they employ Westech spiral scrapers)
8. Scum/grease removal systems are an MTCE issue:
   - 2-inch lines clog frequently.

- Pumps clog frequently—submerged discharge?
- Discharge into second scum well.
- Collections uses triangular pad to pump their wet well cleanings onto. A lot of unwanted grit and sand goes to the drainage well (to the influent end of clarifiers) between clarifiers 3 and 5. This currently drains to the upstream head of the primaries. After the headworks upgrade project this will drain to the Plant headworks.

9. Foam control in aeration basins:
   - classifying selectors
   - flow baffles under step feed channels.
10. Include step feed in alternatives assessment to protect against sludge inventory loss.

Meeting 3. Digester, Gas Management

1. Three functioning digesters currently in service (two primary, one secondary):
   - What is ultimate flow to digesters?
   - Need to define basis of design: maximum or peak rate of loading?
   - Capacity depends on allowable VS load. At 0.15 lb/ft^3, capacity will be reached at max month flow of 29 mgd. At 0.20 lb/ft^3, capacity will be reached at 41 mgd.
2. Spare capacity needed to allow for digester cleanout—cleanout occurs approximately once every 5 years for primary digesters (probably would be a different time frame for secondary digester), at a cost of $100K per cleaning event. Most recent cleaning found 120,000 gallons of solids at the bottom of the digester, tested to be about 20–25 percent volatile. Recommend to do particle size analysis to assess grit removal before and after the headworks upgrade project.
3. Other confounding factors: service area expansion
4. Mix of WAS/PS important for sludge quality going to dryer
5. Current SRT = 33 days
   - <0.09 lb VS/ft^3/day
6. Optimize gas production: currently get 65+ percent VS reduction.
   - Cost of natural gas motivation to maximize gas production. Digester gas → boilers, FMF; cost optimization needed.
   - Balance between maximizing primary sludge production to get highest gas yields and energy utilization vs. energy needed for aeration and producing more WAS and affecting primary sludge/WAS mix and its impact on sludge dryer quality.
7. Maintain FMF product quality:
   - Potential reduction in N content as VS ratio goes down, WAS/primary ratio, i.e., more volatile, no "excess" WAS to dryer.
   - Current product is borderline in N content to be defined as a fertilizer; could be downgraded to a soil conditioner.
8. Optimize gas delivery:
   - At what operating pressure? What would the impact be if operating pressure were changed? If possible, capacity could be increased by increasing the pressure. Negative impacts—structural integrity of the digester, less buffer between operating pressure and venting pressure. Pressure is

currently 15.5 inches (design was 14 inches). Failure is projected at 22-inch. Unclear what the digester could actually handle, was there a safety factor in the design?

- 100 percent digester gas can go to the FMF in summer.
- Supplement with natural gas in winter except when the FMF is offline.
- FMF accepts digester gas/natural gas (NG) blend.
- Boiler will take either NG or digester gas.
- Digester 2 has the same capacity as digester 1, but has smaller gas piping. Currently, gas production is the same for both digesters, but it is believed that in the future, this could become a bottleneck.
- If gas piping in digester 2 were increased, would gas increase, what would be the economic benefit?
- Investigate/assess operation of IRS "black box":
  - fuel ratio control (unstable)
  - pinch points (hydraulic)
  - heavy operator assistance
  - NFPA requirements and insurance issues might not be able to change
  - can change ratio.

9. Building heating to be considered.
10. Digester capacity:
    - Nutrient removal upstream: more? Sludge not significant?
    - Four new digesters in future (based on loading of 0.15 lb VS/ft^3/d).
    - Digester 4 would require relocating of transformer and MCC.
    - When digester 3 goes down there is limited storage—no ability to overflow from 1 and 2. Digesters need to have some sort of gravity overflow system. Currently, digester 3 will overflow to other two digesters, but digesters 1 and 2 do not have process overflows (they do have emergency overflows). Need to improve flexibility of sending sludges between these digesters.
    - Use thickened sludge well in basement as an overflow? This was rejected because the volume is too small, and it is too difficult to clean.
    - Adding digester 4 will not strain electrical infrastructure; digesters 5–8 will.
    - Aim at modular arrangement of digesters including digester support building.
    - Enhancements needed to support annual cleaning of digesters.
11. Gas management:
    - Piping, equipment on digester roof, control, sensors, transfer, conditioning (H_2O siloxane).
    - Siloxane control: impacts RTO, boilers (microturbines, and Waukesha engine if cogeneration is utilized).
    - If cogeneration is a potential process then need to reduce siloxane from digester gas; unlikely that cogeneration will happen because gas is being recovered for dryer (and is not economic).
    - Raise operating pressure to get more gas; issue is storage.
    - Redundancy in filtering/moisture: there is none at present.
    - Isolation valving: need more to allow maintenance/replacement of valves outside of gas room and especially for safety around gas gallery.

Meeting 4. Dewatering and Dryer

1. Dewatering:
   - The centrifuges are rated at 100-gpm capacity, and only one centrifuge (of a total two) can operate at any time.
   - Two centrifuges technically can operate at once, but there would be no way to control flow. Would need to install flow control valves to each unit.
   - Unclear if piping could handle 200 gpm.
   - At 100 gpm, barely able to bring down digester level (barely able to keep up).
2. Using centrifuge to deliver Class B:
   - During maintenance of FMF, RTO cleaning, the centrifuge is used to produce Class B biosolids (happens about once per year).
   - Limited capacity in the wet cake feed bin is the primary bottleneck.
   - Digesters pump to centrifuge, which feeds into wet cake bin. Class B can get removed just upstream of the wet cake bin. So the wet cake bin is the only place to store centrifuge product before it hits the dryer.
   - Cannot remove wet cake for hauling as quickly as it is produced.
   - Wet cake bin fills up.
   - Unable to control pumps (operate at constant speed).
   - Pumps run at full speed.
   - Cannot slow down even were it possible, due to limited storage in the digester.
   - Solution: more storage in wet cake bin (where to put it?), or more storage in the digester.
3. Dryer:
   - No redundancy (but none needed per Ecology).
     - During maintenance, can go to Class B for periods of time.
     - But going to Class B is a challenge (paperwork, hauling, etc.).
   - System flexibility is tied to storage capacity.
     - Only storage availability is in the digester.
     - Currently, one digester used as secondary (storage), this digester is kept around 2/3 full, limited buffer.
     - Ideally, storage digester could serve the following purposes:
       - overflow from primary digesters (for emergencies, and also to help buffer against daily variations)
       - storage while dryer is being maintained.
   - Additional digester storage is a way of getting around dryer redundancy.
   - Storage for periods while other digesters are being cleaned.
   - Digester expansion—always maintain adequate storage.
   - Build new storage units, but design for easy conversion to a primary digester, so when additional digester capacity is needed, you can just convert the storage unit to a primary digester.
4. Dryer capacity:

- Currently operating 4–5 days per week, 24 hours per day.
- Based on this, operating at approximately 65 percent system capacity (24/7 operation).
- Wet cake storage bin is operating at 85 percent capacity.
- Dryer capacity defined in terms of a manufacturing process:
    - Dryer functions as the sum of many component units.
    - Efficiency of each unit impacts overall system capacity.
- "Design" capacity is an unrealistic value—assumes all units operating at 100 percent efficiency, 24 hours, 7 days per week. Does not account for downtime, maintenance, sub-optimal performance, etc.
- Need to redefine capacity in terms of the system.
- Potential to track reliability in real time (system is operating at what percent of its ideal capacity).

Meeting 5. SCADA and UV Disinfection

SCADA improvements:

1. New project dealing with software changes (fiber to copper cable replacement) will fix interfaces; optical converters will go away.
2. I/O capacity to 60 mgd +/-?
3. Need for centralized control scheme?
4. Separate collections supervisory control and data acquisition (SCADA) system will be implemented soon.
5. Control/communication issue with satellite facilities:
    - I/O capacity:
        - no I/O capacity problem with expansion of the Plant
        - expansion will link into backbone and N/S systems.
    - Future SCADA philosophy:
        - Open process will be discontinued; modular programming will allow testing programs first (each separate project) then "insert" program into existing backbone.
        - Limited control from local areas to other local areas so will need to consciously decide in new local areas what remote control needs are.
        - Ultraviolet (UV), FMF: limited or no remote control, STEP screens can be controlled from 270 and 280.
        - Five different places in the Plant that can control anything except UV and FMF.
        - Agreed to continue philosophy of customizing local control like FMF or UV as needed.
        - Need more remote control centers; future expansion philosophy is NOT to centralize.
        - Need for operations management strategy for future expansion that would drive I&C architecture?
        - Not necessarily going to have one person → one area, will have overlapping responsibilities from several areas.
        - Right now have ops 1-2-3, but only work certain areas—will this work in an expanded/diversified Plant?
        - Probably: need to rely on annunciation/strobes to alert Plant-wide.
        - Idea of PDA to see SCADA (wireless notebook).

- Economy-of-scale: manageable system for larger/fluctuating number of staff.
- Have process system analyst on staff? IS system just Plant or entire collection system?
- For remote site:
  - need to see data for Cascadia
  - need to "operate" Cascadia
  - minimize staffing at Cascadia so need to make at least limited remote changes (precision changes made locally).
- Collection system monitoring.

UV system/disinfection:

1. Four channels at 11 mgd each—firm capacity is 33 mgd.
2. Would compromise other processes to expand disinfection channels.
   - Reliability of Wedeco system is questionable: parts, service.
     - Are other UV vendors different in reliability?
     - Last 3 months most stable in life of Wedeco equipment—has been robust and steady (this is not the norm).
     - Wedeco support very limited.
     - Future risk still high; will Wedeco improve enough to retain as UV supplier?
     - Trojan might be more "reliable," but operating cost is higher, and no evidence of better "support" if there are problems, because there are just not any problems.
     - Might need to validate costs.
3. Other technology of merit:
   - Vertical "box" UV-IDI?
   - In-line UV?
4. Planning process:
   - Should focus on continued UV and accommodate some quantity of chlorination for emergencies.
   - Effect on (UV) transmittance from SVI in secondaries.
   - High SVI can lead to less turbid effluent.
   - Other interference from colloids/color/dissolved chemicals.

Meeting 6. Electrical Infrastructure and Utilities

Electrical infrastructure:

- motor-driven generators: 1.25 MW
- substations, medium-voltage feeds
- cable
- sub-feeds (480 and 4160)
- vaults-cable, terminations
- transformers
- switch gears

- primary feed (from meter into Plant).

1. Motor-driven generators (emergency generators):
   - Age = 6 yrs and at capacity now.
   - High reliability.
   - 6-year-old cables—relatively new cable.
   - Can carry almost entire Plant capacity, but must reduce process aeration to two 150-hp blowers, which limits capacity to reach DO targets.
   - Ecology "interested" in emergency generators.
   - Future: supposed to have 200-kW generators only for UV; these will be used up by headworks.
   - Generator is on McNeil feed; need bigger unit on Sunset (≥ 2MW).
   - FMF: 450 kW (Sunset only).
2. Substations (internal) step medium-volt to 480V:
   - M-11: 12470 incoming.
   - U-71: 12470-480.
   - U-81: 12470-480.
   - U-111: 12470-480.
   - U-112: 12470-4160.
   - UV: new, no major issues.
   - FMF: new, has a spare conduit, can feed from McNeil in future.
   - Main concern is age (23 years now, expected life is 30 years).
   - Starting to see problems (circuit breakers):
     - mechanical binding
     - circuit breakers' "brains" failing
     - obsolete and hard-to-find replacement parts.
   - Older substations do not have breaker trolleys:
     - safety issue: "backbreaker" (heavy)
     - complications for County's older workforce, 120-pound heavy unit, no room to maneuver.
3. Cable:
   - Riser pull to meter: 1984 "original," i.e., old.
   - Meters to M11: 84 feet.
   - M11 to load breaks (50-foot run): 2000.
   - Load breaks to 280 subs: 2000.
   - Load break to 15 kVA Ts on McNeil: 2001 (re-pulled 1,200 feet, load break).
   - (Gen) 15 kVA Ts to vault 71: 2001, underground taps for McNeil.
   - Vault M11: (both Sunset and McNeil) to 280: 2006.
   - Vault at 280 to U82 sub electrical boiler: 1984.
   - Replace from 280 vault "on": make this part of any future expansion for cables.

- Vault M11: Vault 71 (Sunset): 1984.
- Vault 71, major vault (U111, U112) 1991.
- Vault 71 to UG1 (UV), McNeil and Sunset: 2002.
- Vault M11 to UG1 (Sunset, FMF): 2006.
- Any 1984 cable is at end of useful life.
- From Tacoma Power: putting industrial customers on fiber optic meters; Plant might be one of first meters replaced (good timing to replace service within 5 yrs.).
- Need to discuss future expansion impacts with Tacoma Power; McNeil already touched for TPU in winter.
- Tacoma Power is considering peak surcharges.

4. Subfeeds (480 and 4160):
   - 480 cable to MCC 81, 82 (digester upgrade), 83 (NE SCADA): 2003
   - Blower building (U111, U112): 1991 U113 (new 150 hp, MCC IF3): 2003
   - UV: 2001–2002
   - 480V to MCC 71, 72, 73: replaced in South End SCADA 2002
   - FMF OVC 2006:
   - Issues:
     - cables connected on secondary side of sub-transformers go to circuit breakers in substations (same issues)
     - mechanical binding: hard to rack in and out
     - hard to close circuit breakers
     - finding new set of issues
     - spring failures
     - electrical control module (brains) fail.
5. Vaults:
   - Cable terminations. Same issues as cables: aging, decaying, obsolete.
   - Crowded now (esp. 71).
   - Installation: no slack at all in 1984 cable.
   - Cleaned cable connections recently; had 6–7 feet mud/water, installed pumps; need to ensure that future vaults (and remainder of existing) need pumps (County has added this to their vault spec).
   - Fortunate that 70–71 did not have major damage (took weeks to dry out).
   - Cleaning from the flooding took 3–4 days, 2 FTEs.
6. Transformers:
   - Age.
   - 1984: 2@270.
   - 3@280.
   - 1991: four at blower building.
   - UV: 2002.

    - FMF: 2000.
    - DGA is like vibration analysis:
        - arcing in winding
        - breakdown in oil
        - highly informative and reliable technical analysis.
    - Industry standard is 30 years; 8 of 11 of the transformers are 6 or 7 years away from 30 years.
    - Capacity on aeration: old MCC protectors knock out (current operations increasing aeration; transformers might not be able to handle capacity needed). Cannot run all three 500 hp blowers at once.
7. MCCs and switchgears:
    - medium-voltage switchgears; same issues as transformers
    - admin building MCC is pre-1984, not Allen Bradley
    - M111: 1991
    - M112: 1991
    - all other MCCs have been replaced.
8. Medium-volt service, primary feeds from Tacoma Power:
    - Load is OK at present:
        - 12470-- 41 amps McNeil, 27 Sunset.
    - Never tested cables from riser poles to meters (will do this year).
    - Assess capacity for baseline future capacity.
    - December 2004: energy audit (good reference).
9. Electrical/operating strategy:
    - Opportunities for "rebates" for projects that reduce power consumption:
        - Air compressor program is offered by Tacoma Power, possible to expand the program to include blowers?
    - Use of Accusine power conditioners for power factor and harmonic control (allowed stability in operations, no VFDs falling out, reduced risk of penalties for peak loading). Accusines are not written up as part of Plant spec.
    - Annual electric bill: demand charge and delivery:
        - $45,000–50,000 per month, of which $8,500–$11,000 is demand charge.
        - Demand charge is a surcharge, not for energy used; sort of a "capacity" charge.
        - How to load level and mitigate? Accusine helps immensely.
    - Removing electrical boilers will reduce operating risk (in progress with CDM.)
    - Power monitoring software will help monitor and avoid load peak impacts/charges.
    - Largest sources of power demand:
        - electric boilers
        - blowers (20 percent)
        - FMF (runs around 270 kW when on, 60 kW when down)

    - total 1.3MW monthly usage.

Utilities:

- natural gas
- potable water
- process water
- communications (phone)
- instrument air
- service air.

1. Natural gas:
    - Could be limited going into boiler room as digester capacity expands; 2-inch-diameter or 4-inch-diameter stub in gas gallery is 4-inch-diameter into Plant—is this adequate in future?
    - Serves the new boilers, heating in the headworks building.
2. Potable water:
    - Vault at bottom of hill is 8" 0 ≈150 psi in vault (very high).
    - PRVs generally OK (recently changed to higher pressure rating), vault pipe is 20 years or greater; pipe only rated to 200 psi.
    - Lack of isolation valves internally whole areas of Plant have to shut down to service PRV.
    - Expansion must consider dramatic change in elevation; vault is at lowest elevation.
    - Big loss in pressure going up the hill from the vault—fire suppression issue.
    - Might need new service location?
3. Process water:
    - Upgraded 1 year after UV.
    - "Cobbled together and running backwards" small diameter → large diameter.
    - Two systems. Low pressure system runs at 85 psi; irrigation affected, high-pressure system → 120 psi. The high-pressure system is fed from the low pressure side.
    - Need comprehensive "network" analysis for whole system:
        - FMF and future expansions in area affected
        - GBTs large "consumers"
        - washwater needs for future capacity in GBTs.
    - The low-pressure system starts at the UV area, crosses Plant, feeding irrigation along the way.
    - High-pressure system is generated at building 280, with four pumps on VFDs. These pumps fight each other; very inefficient.
    - Hellan strainer impacts due to algae from clarifiers, high maintenance load in the summer.
    - Consider a two-step system to filter or address in clarifier design: serpentine weirs in SC 1, 2, 3, 5 are the primary source of algae.
    - HOCl system impacts OK now, redone in 2003 or 2004.
4. Communications (phones/wireless radios):
    - Problems in utilidors: 5-watt two-way radios; working on coverage.

- Some Nextel phones: dead spots in admin; out of County control.
- County phone system works well where phones are located.
- Safety issue: cannot reach all staff in utilidors; working on coverage.

5. Air (service air, or Plant air):
   - Plant air and large compressors in Plant work OK.
   - Plant has two large compressors: one is a standby, plus a separate compressor for the FMF, and a small compressor for the UV.
   - FMF compressor cannot keep up with FMF needs, no backup, will put FMF out of service if fails.
   - Would be nice to have all Plant compressors on one system.
   - Instrument air needs drying, but could be provided from service air system.
6. Utilities improvements: should be done in comprehensive fashion if it makes sense:
   - one plant
   - one system
   - not "hooked together" area systems.