

TC DDA Wi-Fi Proposal for TCLP



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TRAVERSE CITY
LIGHT & POWER
Inventing Our Energy in The



Aspen Wireless Technologies, Inc.

TC DDA Wi-Fi Design Summary

- DDA TIFF district coverage designed for 20dB link budget margin, 3rd AP coverage in high density areas. Planned for future capacity
- 66 Nodes total of which 20 have Fiber connectivity. 27,500 simultaneous users, 3.2Gbps of potential capacity injection
- Aspen Wireless to provide a TURNKEY Wi-Fi SOLUTION using Ruckus Wireless and our WaVE-NOC with a 120 month operations, monitoring and maintenance agreement.

Node Radios

ZoneFlex 7782-S



Dual-band 802.11n
3.3x2, 900 Mbps

Internal sectorized smart antenna for 2.4GHz/5GHz
12 elements, -45 patterns, 120° coverage

- Well suited for high density deployments
- Best coverage and capacity at 120° sectors
- Used for poles and ceiling walls

ZoneFlex 7782




Dual-band 802.11n
3.3x2, 900 Mbps

Omnidirectional smart antenna for 2.4GHz/5GHz
6 elements, +2000 patterns, 360° coverage

- Well suited to a wide variety of deployments including indoor
- Best coverage and capacity at 360°
- Used for poles, rooftops, or parapets

ZoneFlex 7782-E



Dual-band 802.11n
3.3x2, 900 Mbps

External smart antenna support for both 2.4GHz and 5GHz

- Wide variety of external antennas can be attached giving great deployment flexibility
- Ideal for poles, street corners, roof tops
- Shuntco's smart AP is remote from antennas or where IP requires custom engineering IP coverage

ZoneFlex 7782-W

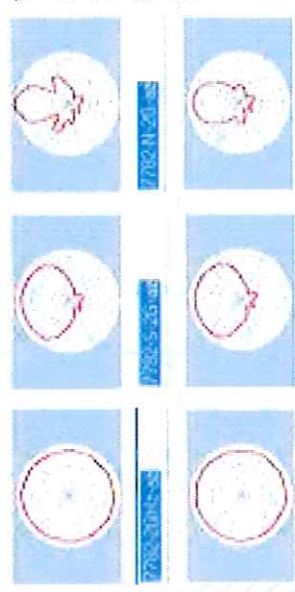


Dual-band 802.11n
3.3x2, 900 Mbps

Internal narrow sectorized smart antenna for 2.4GHz and 5GHz
4 elements, 20° narrow sector coverage

- Well suited to extremely high density deployments
- Can be used in many applications
- Best coverage and capacity at 20°

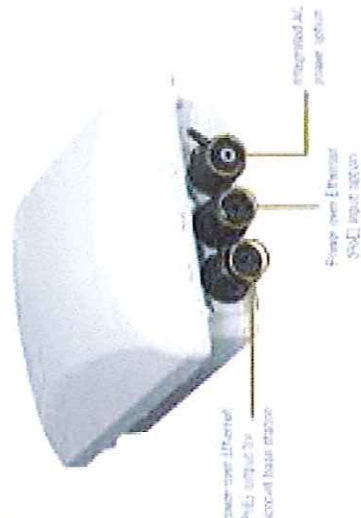
We will use a combination of these to achieve desired coverage pattern



7782-S 360°
7782-S 120°
7782-S 20°
7782-E 360°
7782-E 120°
7782-E 20°
7782-W 20°

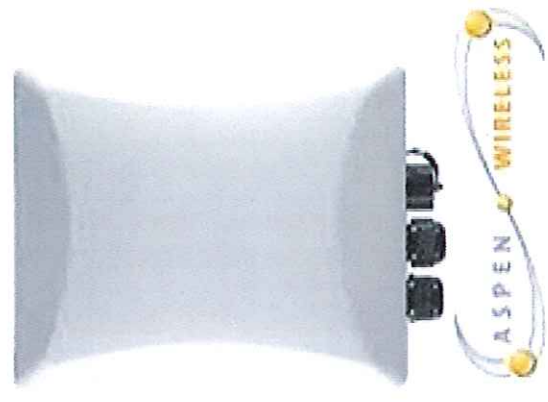
- Concurrent dual-band (5GHz/2.4GHz) support
- Adaptive antenna technology and advanced RF management
- Up to 8x85 signal gain, 15dB interference mitigation
- Chip based transmit beamforming increasing signal gain up to 4dB when used with supported clients
- Automatic interference avoidance, optimized for high-density environments
- Standard 802.3ab/z Power over Ethernet (PoE)
- Polarization Diversity for optimal mobile device performance
- Standard 802.3ah/z output for surveillance cameras or small cell backhaul

- Integrated WAC power
- Integrated GPS for location services and network timing
- Wall, pole or ceiling mountable
- Small, lightweight, and unassuming form factor



- 2 to 4 times extended range and coverage
- Multicast IP video streaming
- 900 Mbps of user throughput (450 Mbps/radio)
- 32 BSSIDs with unique OoB and security policies**
- Advanced QoS packet classification and automatic priority for latency-sensitive traffic
- Continuous Spectrum Analysis
- Dynamic, per-user rate-limiting for hotspot MLANs
- WEP, WPA, WPA2, WPA3, 802.1X support for RADIUS and Active Directory
- Smart Mesh Networking*
- Zero-IT and Dynamic PSK*
- Admission control/loss balancing*
- Band steering and airtime fairness support
- Captive portal and guest accounts**

*Optional with Radius Zero/Active Directory
**IP license



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Aspen Wireless Technologies, Inc.

Physical & Performance Specifications

PHYSICAL CHARACTERISTICS

POWER

- AC Input (100-250 VAC 50/60 Hz)
- Idle: 8W
 - Typical: 10W
 - Peak: 18W (PoE output off)
 - Peak: 50W (PoE output 25W)

PoE Input

- Idle: 6W
- Typical: 8W
- Peak: 802.3at/at (PoE output off)
- Peak: 44W (PoE output 25W)

PHYSICAL SIZE

- 23.9 cm (L), 19.5 cm (W), 11.8 cm (H)

WEIGHT

- 2.4 Kg

ETHERNET PORTS

- PoE Input
- 10/100/1000Base-T 802.3, 802.3u, 802.3ab, 802.3at/at PoE PD Input up to 40W with high power PoE injector
 - Jumbo frame support (2000 byte MTU)

PoE Output:

- 10/100/1000Base-T 802.3, 802.3u, 802.3ab, 802.3at/at PoE PSE Output up to 25W
- Jumbo frame support (2000 byte MTU)

RF (7782, 7782-S, 7782-N)

ANTENNA

- 7782: 2000+ patterns
- 7782-S: 8+ patterns
- 7782-N: 1 pattern

MAXIMUM EIRP (Varies by country)

- 7782: 34 dBm (2.4GHz); 32 dBm (5GHz)
- 7782-S: 39 dBm (both bands)
- 7782-N: 38 dBm (2.4GHz); 42 dBm (5GHz)

PHYSICAL ANTENNA GAIN

- 7782: 3 dBi (both bands)
- 7782-S: 6 dBi (2.4GHz); 8 dBi (5GHz)
- 7782-N: 9 dBi (2.4GHz); 15 dBi (5GHz)

BEAMFLEX* SINR TX GAIN

- Up to 6 dB

BEAMFLEX* SINR RX GAIN

- Up to 4 dB

INTERFERENCE MITIGATION

- 15 dB

MINIMUM RX SENSITIVITY

- -101 dBm (2.4GHz); -96 dBm (5GHz)

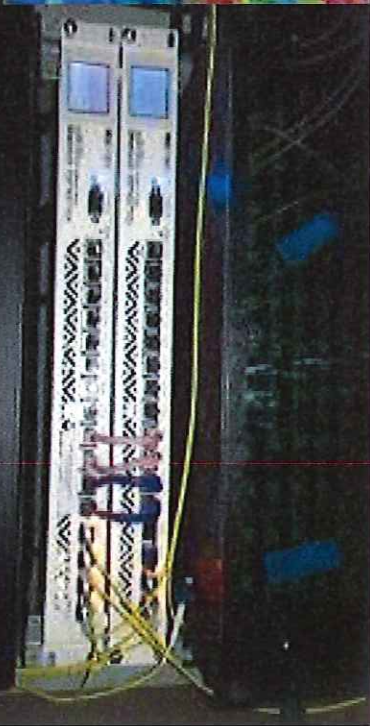
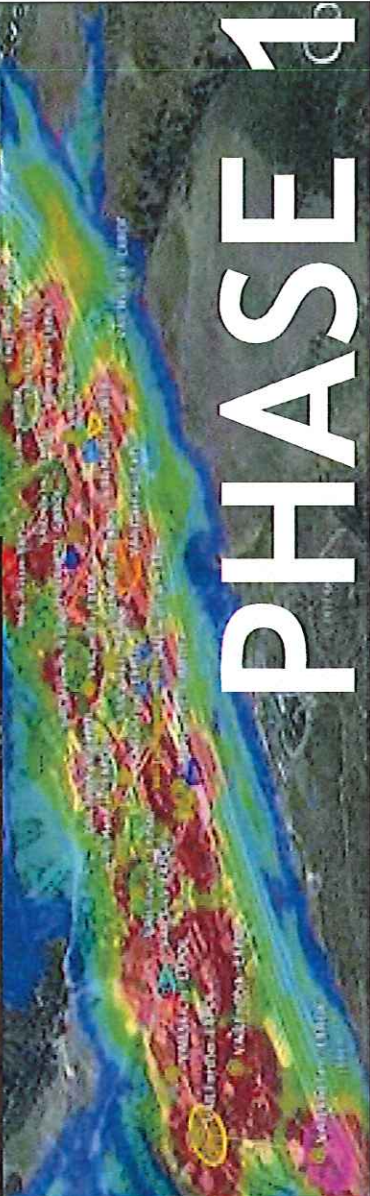
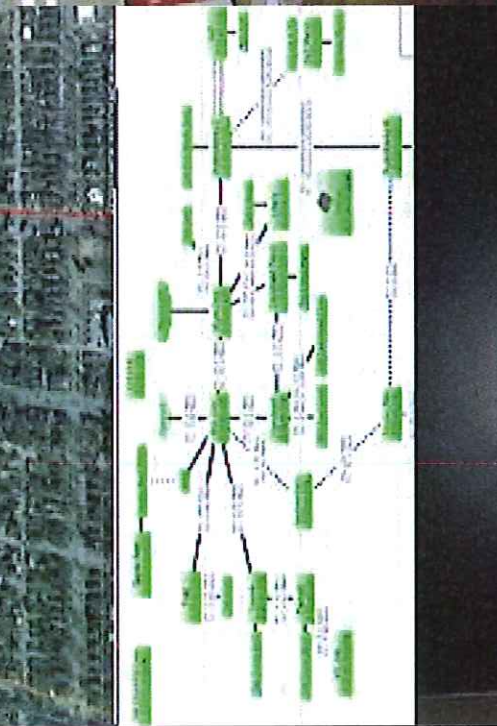
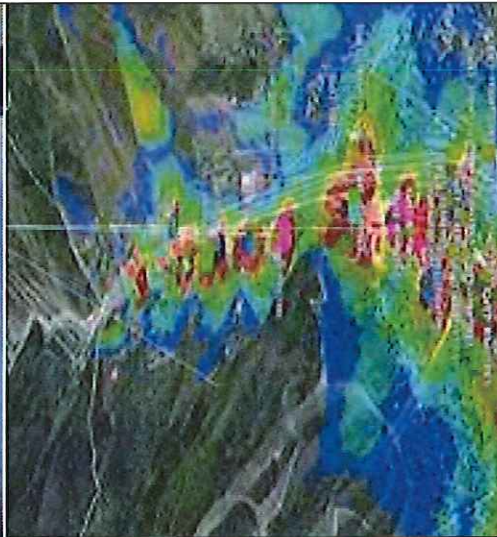
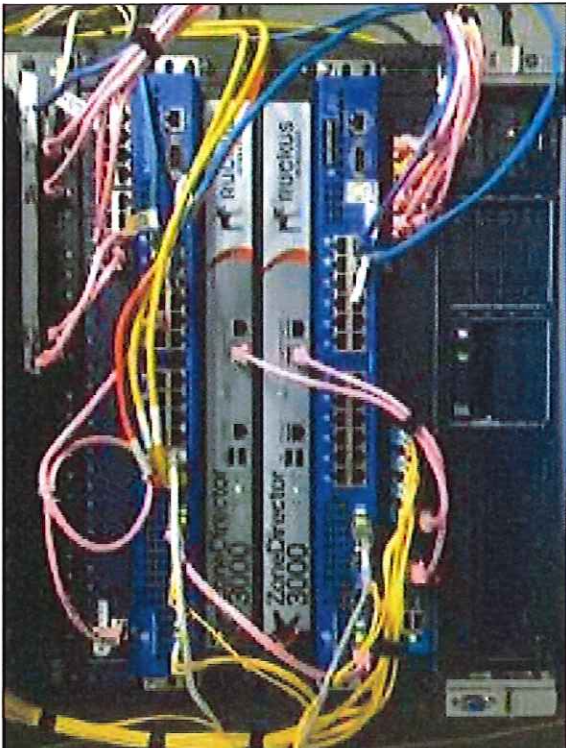
*BeamFlex gains are statistical system level effects translated to enhanced SINR based on observations over time in real-world conditions with multiple APs and many clients



Aspen Wireless Technologies, Inc.

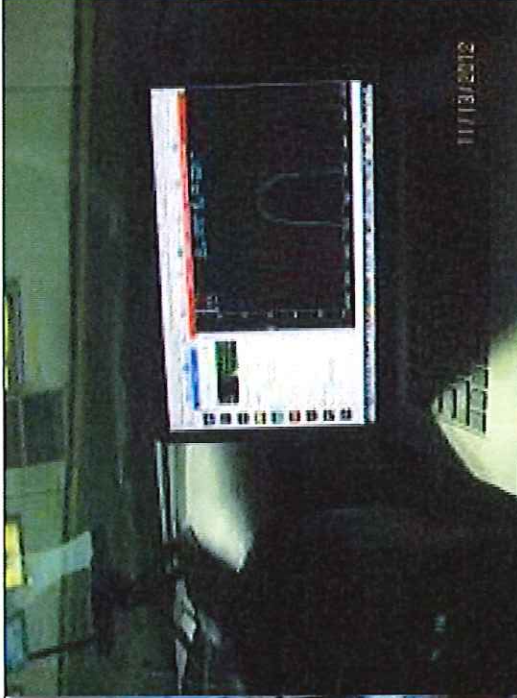
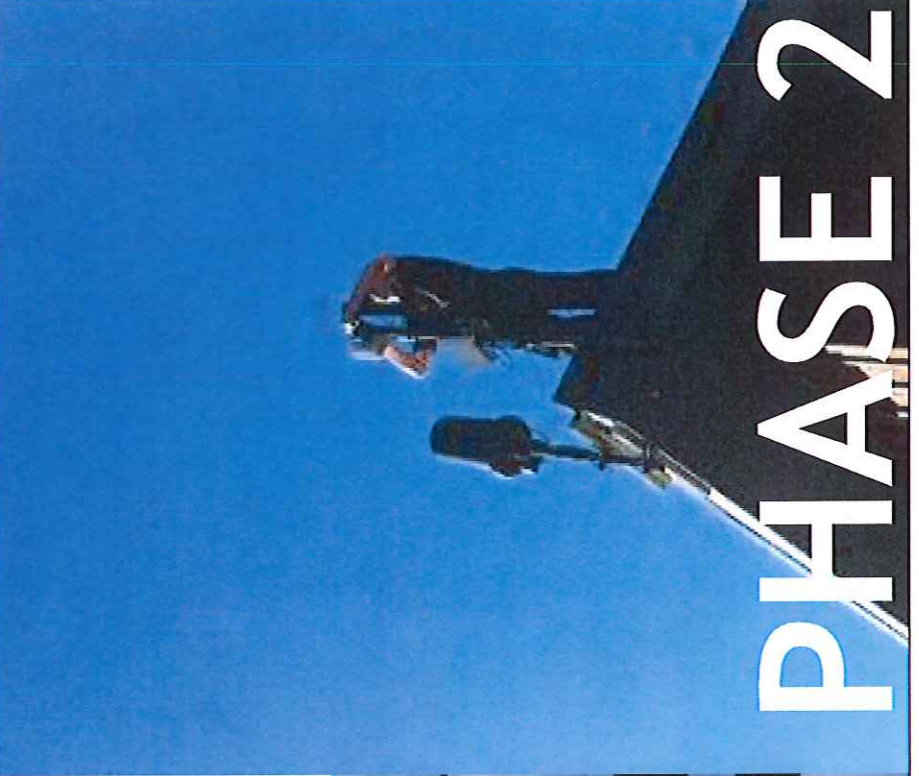
Phased Approach

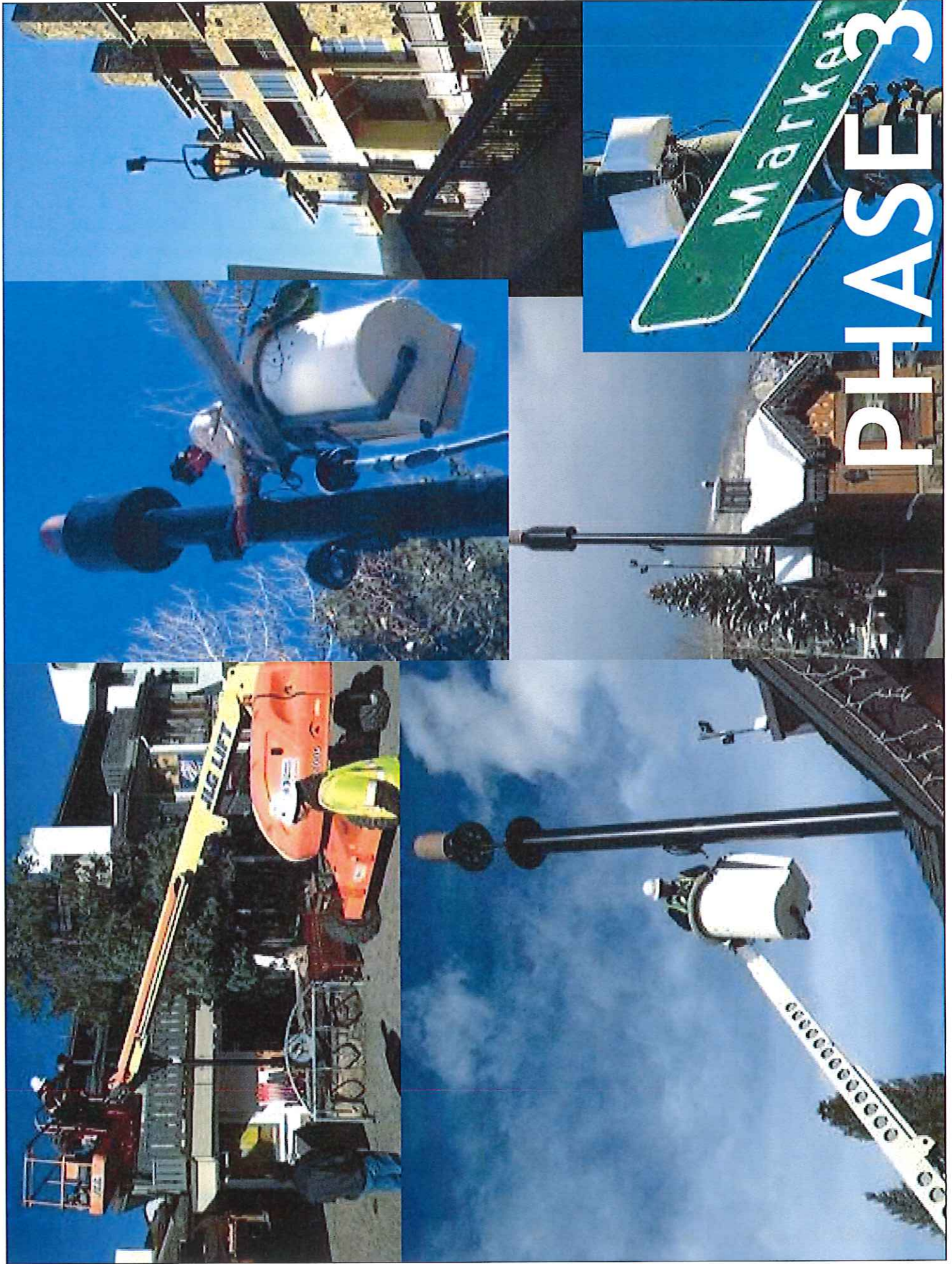
- Phase I - Set up Staging, IP Core, Controllers Network Management Servers and Internet.
- Phase II - Focus on fiber backbone and the Root Wi-Fi Sites. Complete approvals and permitting with TC. 20 Nodes
- Phase III - Standardize on Power and mounting Mesh Wi-Fi sites mainly on TCLP poles. 46 Nodes



PHASE 1

PHASE 2





PHASE 3

Fiber and Power Considerations in our Turnkey Design

We have 8 root sites in the design with Fiber IP connectivity. Need consistency throughout the build.

All Wi-Fi and hub equipment specified fits in standard 19" Rack mount

Need to look thru form factor streetlight mounting to accommodate node power supplies? 120v or PoE?

Quoted with 12 Fibers, pigtail, panel and turnkey and access to their own IP core for TCLP applications

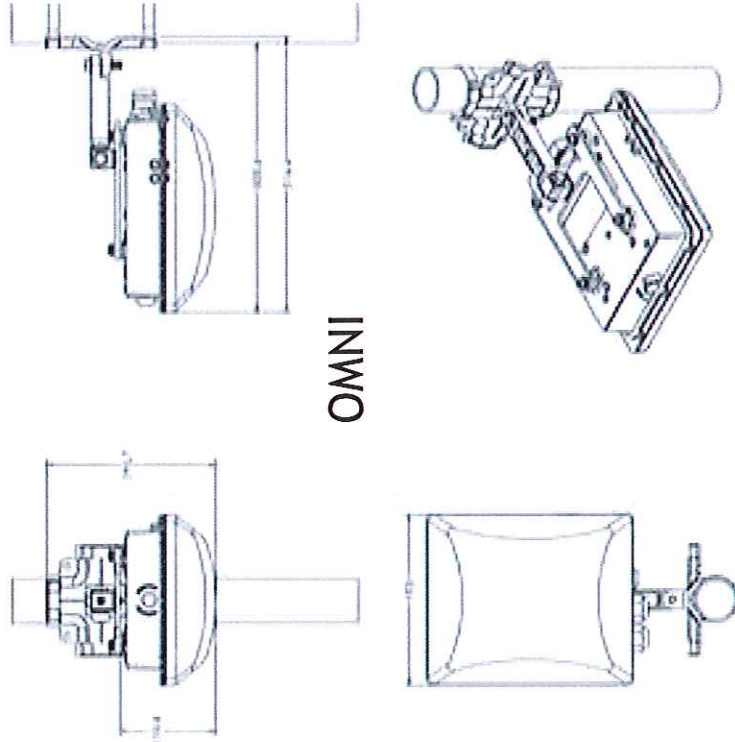
Same design at every site simplifies aesthetics approval, operational costs and integration time



Aspen Wireless Technologies, Inc.

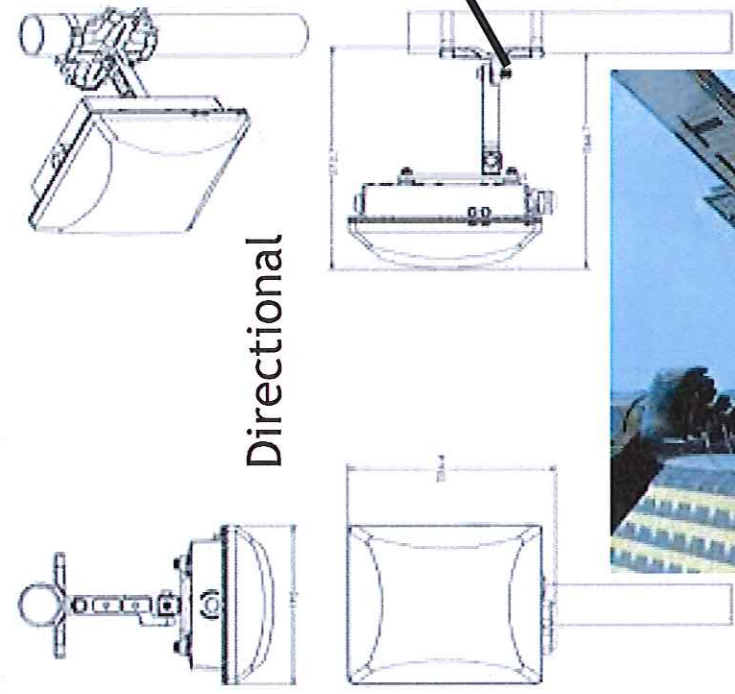
Node Dimensions and attachment detail

Figure 43. Dome-down mounting maximum dimensions



OMNI

Figure 42. Sector mounting maximum dimensions

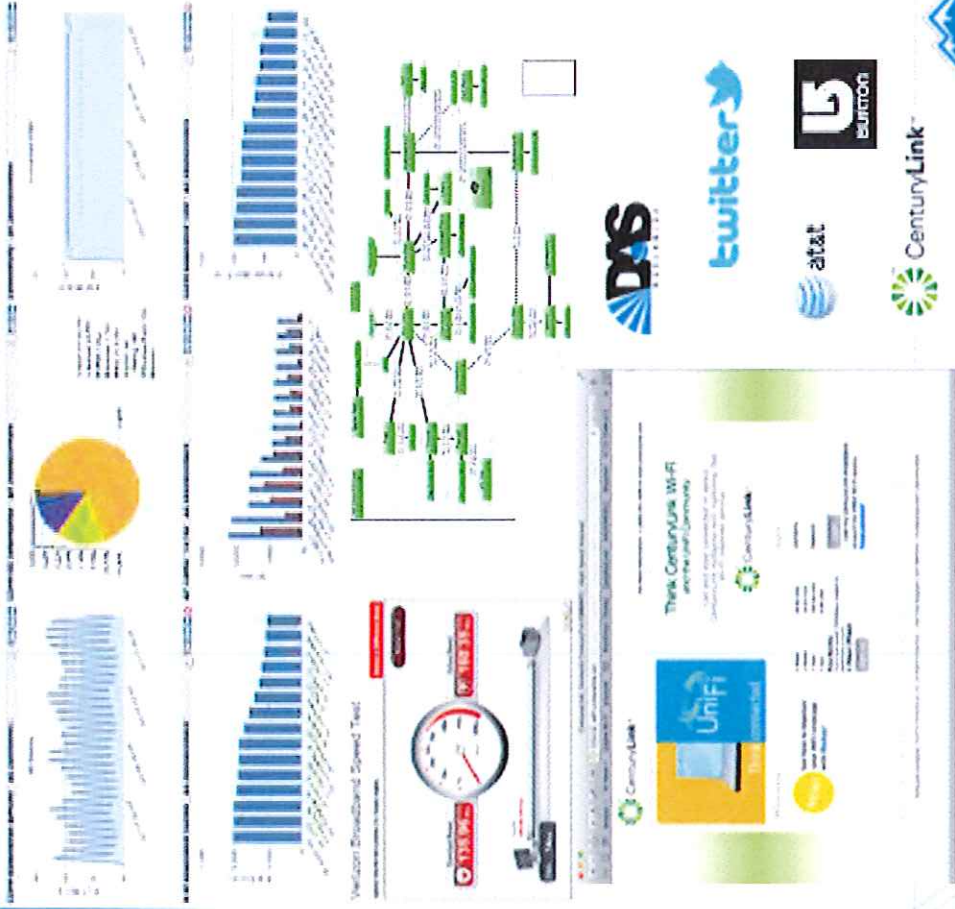


Directional



Aspen Wireless Technologies, Inc.

Aspen Wireless will Manage and Operate with WaVE-NOC



- since 2006 our Wireless and Virtual Network Operations Center (WaVE-NOC) is PROVEN DAILY in large deployments.
- Wi-Fi centric expertise with tiered support. Our techs have real-time visibility to deploy, control, monitor and upgrade components or users.
- As the network technology evolves, ASPEN WIRELESS will place measures to enhance the network and make system changes for better support and increasing operational margin, which is included in the monthly recurring rate.
- \$800/month includes 10 year warranty on hardware, software and all maintenance for a carefree experience.



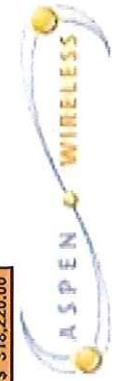
Satisfied Customers using WaVE-NOC:



Aspen Wireless Technologies, Inc.

Node Locations and Details

Node	Location	Latitude	Longitude	Fiber	Power	Radio	Network	Maints	Enclosure	TOTALS
Mesh-01	westbay	44.7671129	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-02	NorthBrow	44.76398039	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-03	Volleyball	44.76532893	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-04	openspacc	44.7665775	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-05	warehouseindist	44.7661287	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-06	watrain	44.76494194	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-07	shamberg	44.76410876	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-08	river	44.76254888	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-09	unionstreetbridge	44.76532862	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-10	reconstrange	44.76411714	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-11	mainwest eMesh	44.76685632	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-12	mainwest	44.76685632	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-13	welcometr	44.76581989	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-14	starcumion	44.76281175	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-15	oldtowne eMESH	44.76003875	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-16	citybike	44.76103391	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-17	oldtowne	44.76002143	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-18	oldtowne south	44.758666	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-19	union&8th	44.75924632	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-20	unionstreet	44.76342695	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-21	paingona	44.76413894	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-22	AITCO	44.76283597	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-23	cherryvalley	44.76352505	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-24	cherryrepublic	44.76412935	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-25	farmersmarket	44.76546145	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-26	FarmersMarket eMesh	44.7654374	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-27	mueltede	44.76296676	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-28	Cross Bridge	44.76442993	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-29	freelily	44.76100894	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-30	midtown	44.76017936	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-31	mainstreet	44.766839148	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-32	backcountry	44.76415841	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-33	chasehall	44.7634545	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-34	starcumion	44.7628505	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-35	starcheatre	44.76402278	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-36	Chase Park	44.76408888	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-37	patisserie amie	44.75949415	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-38	sestato&park	44.75925223	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-39	Front&Park	44.76406436	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-40	inverneast eMesh	44.75860862	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-41	inverneast	44.75855977	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-42	frontsvoga eMESH	44.76415273	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-43	moultonboardman	44.76415273	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-44	Burbas	44.76417295	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-45	realtorow	44.76417295	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
Mesh-46	ion&grandview	44.76420685	N/A		\$ 620.00	\$ 2,700.00		\$ -	\$ 150.00	\$ 3,470.00
ROOT-01	Cabinet #6	44.76539439	\$ 3,750.00		\$ 5,500.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ 3,500.00	\$ 18,250.00
ROOT-02	Cabinet #6 East	44.76539439	\$ 3,750.00		\$ 2,750.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ 1,500.00	\$ 11,850.00
ROOT-03	Hall St. Sub South	44.76494678	\$ 2,100.00		\$ 2,750.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ 400.00	\$ 11,850.00
ROOT-04	Hall St. Sub North	44.7650921	\$ 2,100.00		\$ 350.00	\$ 2,700.00	\$ 350.00	\$ 400.00	\$ -	\$ 3,800.00
ROOT-05	Opera Hall SW	44.76398987	\$ 2,100.00		\$ 1,750.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ 1,750.00	\$ 11,100.00
ROOT-06	Opera Hall North	44.76401309	\$ 400.00		\$ 400.00	\$ 2,700.00	\$ 350.00	\$ 400.00	\$ -	\$ 4,250.00
ROOT-07	Opera Hall SE	44.76398683	\$ 400.00		\$ 400.00	\$ 2,700.00	\$ 350.00	\$ 400.00	\$ -	\$ 3,900.00
ROOT-08	Old Town Parking	44.75959067	\$ 2,100.00		\$ 2,250.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ 1,750.00	\$ 12,100.00
ROOT-09	Zoo	44.76608915	\$ -		\$ 1,250.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ 600.00	\$ 7,350.00
ROOT-10	Zoo 2	44.76612494	\$ -		\$ 400.00	\$ 2,700.00	\$ 350.00	\$ 400.00	\$ -	\$ 3,850.00
ROOT-11	Old Towne Parking NE	44.76013104	\$ -		\$ 1,200.00	\$ 2,700.00	\$ 350.00	\$ 600.00	\$ 600.00	\$ 5,450.00
ROOT-12	FIM	44.76396851	\$ 3,750.00		\$ 2,500.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ 800.00	\$ 12,550.00
ROOT-13	FIM South	44.76354499	\$ -		\$ 400.00	\$ 2,700.00	\$ 350.00	\$ 400.00	\$ -	\$ 3,850.00
ROOT-14	FIM West	44.76397396	\$ -		\$ 400.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ -	\$ 3,500.00
ROOT-15	Parking #1 NormWest	44.76336687	\$ 2,100.00		\$ 1,200.00	\$ 2,700.00	\$ 2,400.00	\$ 400.00	\$ 1,750.00	\$ 10,550.00
ROOT-16	Parking #1 South	44.76302368	\$ -		\$ 1,200.00	\$ 2,700.00	\$ 350.00	\$ 450.00	\$ 600.00	\$ 5,300.00
ROOT-17	Parking #1 North	44.76374545	\$ -		\$ 400.00	\$ 2,700.00	\$ 350.00	\$ 450.00	\$ 600.00	\$ 4,500.00
ROOT-18	Parking #1 SouthEast	44.76301656	\$ -		\$ 400.00	\$ 2,700.00	\$ 350.00	\$ 450.00	\$ -	\$ 3,900.00
ROOT-19	400B boardman	44.76050819	\$ 3,750.00		\$ 2,500.00	\$ 2,700.00	\$ 3,000.00	\$ 800.00	\$ 1,750.00	\$ 14,650.00
ROOT-20	HASTING CORE	44.76050819	\$ 2,100.00		\$ 1,750.00	\$ 3,000.00	\$ 4,800.00	\$ 800.00	\$ 2,000.00	\$ 14,450.00
NODE COSTS \$ 22,350.00 \$ 56,020.00 \$ 178,500.00 \$ 28,250.00 \$ 8,800.00 \$ 24,100.00 \$ 318,220.00										



Aspen Wireless Technologies, Inc.



TCLP DDA WI-FI Turnkey Proposal

Capital Expenditures		QTY	Type	Cost	U/M	Total
Node Testing, Turn up, NMS integration TCLP Alarms, turn over to WaVE-NOC						
Project Management, Systems Admin, Programming Controller and DDA integration						
Node testing and optimization						
		3	wks	\$ 2,500	week	\$ 7,500.00
		1	links	\$ 4,800	ea	\$ 4,800.00
		3	IPCore	\$ 2,000	ea	\$ 6,000.00
		8	POP sites	\$ 400	ea	\$ 3,200.00
		2	servers	\$ 6,000	ea	\$ 12,000.00
		5	1000' box	\$280.00	ea	\$ 1,400.00
		8	hardware	\$ 1,200	ea	\$ 9,600.00
		1	hardware	\$ 14,000	ea	\$ 14,000.00
		1	software	\$ 5,000	5yr	\$ 5,000.00
				Headend Costs		\$ 63,500
				Node Costs		\$ 318,220
				Capital Expenditures		\$ 381,720

Operating Expenses		QTY	Type	Cost	U/M	Total
Aspen Supervision and Maint.						
		10	Years	\$ 2,400.00	/yr	\$ 24,000.00
Aspen Contracted Maint and Materials						
		10	Years	\$ 7,200.00	/yr	\$ 72,000.00
				10 yr Operating Expense		\$ 96,000.00



Major Savings Achieved with Turnkey Solution

	Original Proposal	Turnkey Proposal
Capital Expenses	\$ 526,760.00	\$ 381,720.00
Operating Expenses	\$ 154,000.00	\$ 96,000.00
TOTAL over 10 yrs	\$ 680,760.00	\$ 477,720.00
	10 yr cost savings	\$ 203,040.00
	Lost interest reduced 28%	\$ 7,494.64
Total Savings with New Turnkey Quote		\$ 210,534.64

Also allows TCLP Staff not to be distracted from their core business.



TRAVERSE CITY
LIGHT & POWER
Innovating Our Energy in The



Aspen Wireless Technologies, Inc.

Please contact for procurement and
contracting

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(970) 948-9998



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Aspen Wireless Technologies, Inc.

Traverse City Light and Power											
WIFI Project - OPTION A											
March 4, 2014											
	FYE 6/30/2014	FYE 6/30/2015	FYE 6/30/2016	FYE 6/30/2017	FYE 6/30/2018	FYE 6/30/2019	FYE 6/30/2020	FYE 6/30/2021	FYE 6/30/2022	FYE 6/30/2023	FYE 6/30/2024
Beginning Cash Flow	\$ -	\$ (465,720.00)	\$ (229,424.58)	\$ (198,827.00)	\$ (167,428.92)	\$ (135,291.94)	\$ (102,416.69)	\$ (69,056.28)	\$ (46,333.38)	\$ (31,375.61)	\$ (15,722.65)
Operating Revenue											
Fiber tariff fee	-	39,600.00	39,600.00	39,600.00	39,600.00	39,600.00	44,550.00	44,550.00	44,550.00	44,550.00	44,550.00
Pole attachment fee	-	525.00	538.13	551.58	565.37	579.50	593.99	608.84	624.06	639.66	655.65
Subtotal Operating Revenue	-	40,125.00	40,138.13	40,151.58	40,165.37	40,179.50	45,143.99	45,158.84	45,174.06	45,189.66	45,205.65
Operating Expenses											
TCL&P Supervision and Maintenance	-	7,500.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00
Aspen Supervision and Maintenance	-	2,400.00	2,400.00	2,400.00	2,400.00	2,400.00	2,400.00	2,400.00	2,400.00	2,400.00	2,400.00
Aspen Contracted Maintenance and Materials	-	7,200.00	7,200.00	7,200.00	7,200.00	7,200.00	7,200.00	7,200.00	7,200.00	7,200.00	7,200.00
Internet Access Connection (Meritt Network)	-	12,650.00	11,100.00	11,100.00	11,100.00	11,100.00	11,100.00	11,100.00	11,100.00	11,100.00	11,100.00
City Fee	-	2,006.25	2,006.91	2,007.58	2,008.27	2,008.98	2,257.20	2,257.94	2,258.70	2,259.48	2,260.28
Insurance	-	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
Lost interest earnings	-	5,948.33	5,205.51	4,454.59	3,704.01	2,953.77	2,208.83	1,464.26	760.06	67.24	-
Inflation cost	-	-	490.00	439.75	450.74	462.01	473.56	485.40	497.54	509.98	522.72
Subtotal Operating Expenses	-	38,704.58	34,402.42	33,601.92	32,863.02	32,124.76	31,639.59	30,907.60	30,216.30	29,536.70	29,483.00
Operating Income	-	1,420.43	5,735.71	6,549.66	7,302.35	8,054.74	13,504.40	14,251.24	14,957.76	15,652.96	15,722.65
Nonoperating Revenue											
TIF 2 Contribution	-	210,000.00	-	-	-	-	-	-	-	-	-
TIF 97 Annual Contribution	-	24,875.00	24,861.87	24,848.42	24,834.63	24,820.50	19,856.01	8,471.66	-	-	-
Total nonoperating revenue	-	234,875.00	24,861.87	24,848.42	24,834.63	24,820.50	19,856.01	8,471.66	-	-	-
Capital costs											
Capital expenditures	381,720.00	-	-	-	-	-	-	-	-	-	-
TCL&P installation costs	20,000.00	-	-	-	-	-	-	-	-	-	-
CIP incurred to date	64,000.00	-	-	-	-	-	-	-	-	-	-
Subtotal Capital Expenditures	465,720.00	-	-	-	-	-	-	-	-	-	-
Net cash provided (used) for WIFI project	(465,720.00)	234,875.00	24,861.87	24,848.42	24,834.63	24,820.50	19,856.01	8,471.66	-	-	-
Ending Cash Flow	(465,720.00)	(229,424.58)	(198,827.00)	(167,428.92)	(135,291.94)	(102,416.69)	(69,056.28)	(46,333.38)	(31,375.61)	(15,722.65)	(0.00)
Total Amount Due from DDA	-	275,000.00	65,000.00	65,000.00	65,000.00	65,000.00	65,000.00	53,630.50	45,174.06	45,189.66	45,205.65
Notes:											
1) Fiber contracts tend to be on a five year basis with inflation costs built in for the next five years, assuming 2.5 percent for each year equates to a 12.5 percent increase.											
2) Fiber connection revenues is based on six connections and full redundancy tariff.											
3) Pole attachment fee is based on 50 poles at \$10.50 each with a 2.5 percent increase each year.											
4) Inflation costs does not include City fee or Aspen costs.											
5) Inflation based on 2.5% year and lost earnings based on 2.0% a year.											
6) If DDA TIF 2 does not renew, terminated, or amended to reduce its annual revenue to below the annual reimbursement fee is due and payable (capital portion.)											
7) After the 10 years the fiber agreement or pole rental fees continue until the WIFI system is no longer utilizing those assets.											
8) As stated in the proposal there is a ten year warranty on hardware, software and maintenance.											



TRAVERSE CITY
LIGHT & POWER

To: Light & Power Board
From: Tim Arends, Executive Director 
Date: March 19, 2014
Subject: Cost of Services Study / Energy Supply Presentation #5

Included in your packet are two documents, the first documents is a power point presentation from Utility Financial Solutions ("UFS") who is assisting TCL&P with its energy supply education presentation and has incorporated actual numbers for the utility from the recently completed cost of service study. The second document is the electric cost of service study for TCL&P dated March 10, 2014.

While Mark Beauchamp of UFS will go into greater detail on the recommendations from the cost of services study, it did recommend that TCL&P is not charging enough to cover its actual cost of services provided and suggest an increase of 1.5% this coming fiscal year and 2.5% every other year for the next four years. This comes as no surprise, as it is consistent with my expectations as expressed to the board on several occasions.

The study further concludes that some customer classes are subsidizing other customer classes. To remedy this, there will be a need for some rate shifting among the various customer classes. This is typical rebalancing that occurs among rates over time.

I realize there is more information in this packet than you have time to review, but we will be prepared to answer your questions at the meeting, or any follow-up questions after the meeting.

Determining Revenue Requirements for Your Utility

Mark Beauchamp, CPA, CMA, MBA
President
Utility Financial Solutions
616-393-9722

Objectives

- ▶ Training Using TCL&P's Data
 - Financial factors considered in determining rate adjustments
 - Financial Projections and Long Term Rate Track
 - Cost of Service Results
 - Monthly Customer Charge
 - Seasonal Charges
- ▶ Requesting Direction on the following:
 - Rate Adjustment Proposed
 - Minimum Cash Reserves
 - Rate Design for Customer Classes

Determination of Revenue Requirements

How much should you recover from Customers?

Methods to Identify Revenue Requirements

- ▶ Cash Basis
- ▶ Utility Basis
- ▶ Debt Coverage Ratio Target

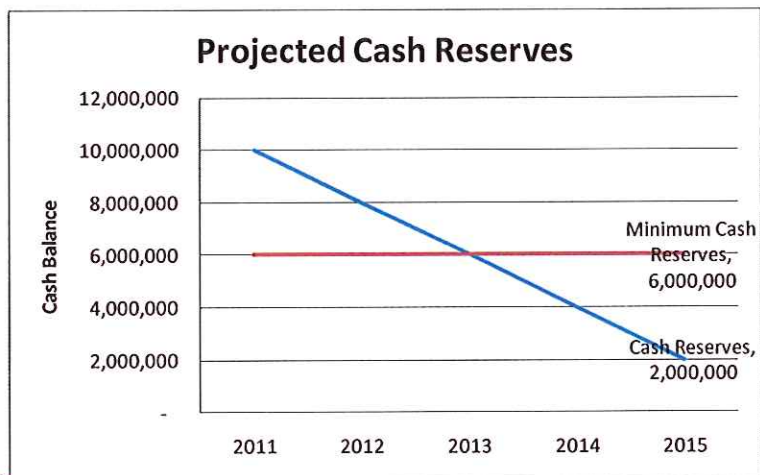
Methods to Determine Revenue Requirements

- ▶ Method One – Cash Basis
 - O&M Expense
 - Debt Service
 - Normalized Capital Improvements
 - Funding of Repair and Replacement (R&R)
 - May be set by financial policy of utility

Many Public Power System only Considers Cash Inflows

- ▶ If repair and replacement account is not funded, reserves may not exist to fund the replacement of infrastructure
 - Results in next generation paying for infrastructure repairs and replacements and higher rates
 - Tends to result in unstable rates and leads to large rate adjustments in the future

Using Cash Reserves to Fund Needed Rate Adjustments



Method Two – Utility Basis Revenue Requirements

- ▶ Used by IOU's and some Public Power Systems:
 - O&M Expense
 - Depreciation Expense
 - Rate of Return – Breakeven
 - Interest Expense
 - Inflationary increase in asset replacement costs

Depreciation Expense

- ▶ Recovers the theoretical use of the infrastructure
- ▶ When customers use assets provided by the Utility they are consuming or wearing down the assets
- ▶ Prevents current customers from either subsidizing or being subsidized by future customers
- ▶ The cash outflows may not occur in the current year, but will be incurred at a future time to replace the infrastructure being consumed by the current customers

Rate of Return

- ▶ Why a public power system needs a rate of return
 - The rate of return is **not** set to make money but for the utility to breakeven
 - The rate of return is set sufficient to cover interest expense on debt
 - The rate of return adjusts for inflation, assets being consumed today will be more expensive to replace in the future

Factors Important to Maintaining the Financial Health of the Utility

How much should you recover from
Customers?

Three Main Factors to Assessing the Financial Condition of the Utility

- ▶ Debt Coverage Ratio (Bond Covenant)
- ▶ Level of Cash Reserves (Cash Basis)
- ▶ Target Operating Income (Utility Basis)

What is Debt Coverage

- ▶ Bond covenants help to ensure repayment of debt and are defined in the ordinance when the bond was issued
- ▶ Bond covenants may be unique to each bond issue, typically identifies the required amount of cash generated by operations above the debt service payment
- ▶ Referred to as debt coverage ratio

General Calculation

- ▶ Cash Generated by Operations divided by Debt Service
- ▶ Typical Formula:
 - Net Income, plus depreciation expense plus interest expense
 - Divided by Debt Service Payment
- ▶ Typical requirements are 1.10X - 1.25X

Bond Covenant Specifies Minimum

- ▶ When setting rate policies a safety factor must be built into the coverage ratio for planning and projection purposes
 - Electric sales are dependent on weather
 - Power supply prices can fluctuate
 - Unexpected expense can occur
 - Unexpected Transfers to City
- ▶ Any of these can potentially cause the utility to fall below coverage requirements
- ▶ Safety factor of 0.2 is typically added to Bond Coverage requirement

Debt Coverage Ratio Example

TCL&P is Currently Debt Free

	Utility Basis	Cash Basis with R&R Funding	Cash Basis with out R&R Funding	Cash Basis with out Drawdown of Cash Reserves
Add Net Income	\$ 1,900,000	\$ 1,900,000	\$ 302,645	\$ (2,327,541)
Add Depreciation Expense	3,000,000	3,000,000	3,000,000	3,000,000
Add Interest Expense	1,000,000	1,000,000	1,000,000	1,000,000
Cash Available for Debt Service	<u>\$ 5,900,000</u>	<u>\$ 5,900,000</u>	<u>\$ 4,302,645</u>	<u>\$ 1,672,459</u>
Debt Principal and Interest	\$ 3,000,000	\$ 3,000,000	\$ 3,000,000	\$ 3,000,000
Projected Debt Coverage Ratio (Covenar	1.97	1.97	1.43	0.56
Minimum Debt Coverage Ratio	<u>1.40</u>	<u>1.40</u>	<u>1.40</u>	<u>1.40</u>

Why is a Cash Reserve Policy Important

- ▶ Helps to ensure timely payment of bills
 - Operating Expenses
 - Debt Service Payments
 - Capital Improvements
- ▶ Creates a reserve fund if catastrophic events
 - Hurricanes/Ice Storms/Wind Storms
- ▶ Helps ensure funds exist for system improvements and reliability
- ▶ Rating agencies consider this a significant factor when considering bond ratings

Cash Reserve Policy

- ▶ Policy should contain a **minimum** amount of cash **not** a targeted amount
 - Cash reserves will fluctuate over time and depends on the age of the system and capital improvement program
- ▶ Some utilities have lowered rates because cash reserves were above targeted amounts only to incur substantial replacement costs a few years later resulting in rate increases

Cash Reserves and Minimum Cash Requirement Calculation

	Percent Allocated	Projected 2015	Projected 2016	Projected 2017	Projected 2018	Projected 2019
Operation & Maintenance (Less Depreciation Expense & Power Supply)	11%	\$ 871,541	\$ 910,328	\$ 938,112	\$ 960,343	\$ 966,337
Power Supply	9%	2,307,520	2,260,446	2,349,811	2,539,554	2,377,881
Historical Rate Base	1%	763,384	820,934	876,534	929,534	966,034
Current Portion of Debt Service	0%	-	-	-	-	-
Five Year Capital Improvements - Net of Bond Proceeds	20%	6,507,400	6,507,400	6,507,400	6,507,400	6,507,400
Minimum Cash Reserve Levels		\$ 10,449,848	\$ 10,499,108	\$ 10,671,857	\$ 10,736,832	\$ 10,857,653
Restricted Reserves		\$ 9,525,000	\$ 9,525,000	\$ 9,525,000	\$ 9,525,000	\$ 9,525,000
Unrestricted Reserves		\$ 5,480,448	\$ 3,839,947	\$ 2,453,401	\$ 1,274,717	\$ (267,883)

Target Operating Income (Rate of Return)

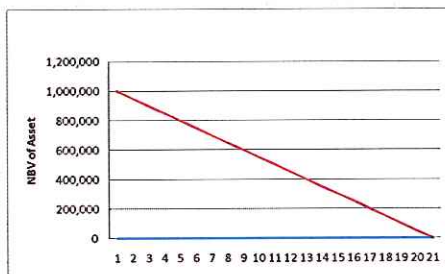
- ▶ Rate of Return is used to identify the level of operating income
- ▶ Operating Income has to be set high enough to cover the following:
 - interest expense on debt
 - Inflationary increase in asset replacement costs

Target Operating Income

	Projected 2015	Projected 2016	Projected 2017	Projected 2018	Projected 2019
Interest Expense on Debt	\$.	\$.	\$.	\$.	\$.
System Equity	2,442,830	2,626,990	2,804,910	2,974,510	3,155,310
Target Operating Income	\$ 2,442,830	\$ 2,626,990	\$ 2,804,910	\$ 2,974,510	\$ 3,155,310
Projected Adjusted Operating Income	1,795,964	1,434,818	1,168,385	976,828	747,773
Rate of Return in %	5.0%	5.0%	5.1%	5.2%	5.3%

Why Inflation has to be doubled

$\$1,000,000 \times 3\% =$
 $\$30,000$
 $\$500,000 \times 6\% =$
 $\$30,000$



Net Book Value of Asset over its Useful Life

Annual Return on Asset

Integration of Financial Targets into Financial Projection

The long term financial projection is used to develop a long term rate track, incorporates the three methods and attempts to balance the strenghts and weaknesses into one projection:

Financial Projection No Rate Adjustments

Fiscal Year	Projected Rate Adjustments	Projected Revenues	Projected Expenses	Adjusted Operating Income	Unreserved & Undesignated		Capital Improvements	Bond Issues	Debt Coverage Ratio
					Cash & Investment Balance	Reserved Cash & Investment Balance			
2015	0.00%	\$ 37,224,972	\$ 35,437,939	\$ 1,787,033	\$ 5,480,448	\$ 9,525,000	\$ 9,072,000	-	n/a
2016	0.00%	36,919,545	35,493,300	1,426,245	3,898,947	9,525,000	5,755,000	-	n/a
2017	0.00%	38,110,010	36,950,319	1,159,691	2,453,401	9,525,000	5,560,000	-	n/a
2018	0.00%	38,219,712	37,251,708	968,004	1,274,717	9,525,000	5,300,000	-	n/a
2019	0.00%	38,874,005	38,135,194	738,811	(267,883)	9,525,000	5,650,000	-	n/a
Recommended Target in 2015				\$ 2,442,830	\$ 10,449,846				1.40
Recommended Target in 2019				\$ 3,155,310	\$ 10,857,653				1.40

Financial Projection Recommended Rate Track

Fiscal Year	Projected Rate Adjustments	Projected Revenues	Projected Expenses	Adjusted Operating Income	Unreserved & Undesignated		Capital Improvements	Bond Issues	Debt Coverage Ratio
					Cash & Investment Balance	Reserved Cash & Investment Balance			
2015	1.50%	\$ 37,746,155	\$ 35,437,939	\$ 2,308,216	\$ 6,001,632	\$ 9,525,000	\$ 9,072,000	-	n/a
2016	0.00%	37,447,333	35,520,745	1,926,588	4,925,685	9,525,000	5,765,000	-	n/a
2017	2.50%	39,315,962	37,013,028	2,302,933	4,633,648	9,525,000	5,560,000	-	n/a
2018	0.00%	39,443,745	37,315,357	2,128,388	4,637,150	9,525,000	5,300,000	-	n/a
2019	2.50%	40,825,969	38,236,696	2,589,273	4,978,636	9,525,000	5,650,000	-	n/a
Recommended Target in 2015				\$ 2,442,830	\$ 10,449,846				1.40
Recommended Target in 2019				\$ 3,155,310	\$ 10,868,818				1.40

Ratemaking for Boards

Mark Beauchamp, CPA, CMA, MBA
President
Utility Financial Solutions

616-393-9722

Cost of Service Summary

- ▶ Compares revenues from each class of customers with costs to provide service to each class.
- ▶ Used to determine the potential change in overall costs for each customer class

Cost of Service Summary

Customer Class	Cost of Service	Projected Revenues	% Change
General Service	\$ 4,160,883	\$ 4,067,955	2%
Senior Space	17,151	17,270	-1%
Senior Residential	992,979	759,742	31%
Senior Water	77,152	61,719	25%
Residential Space Heating	75,370	78,252	-4%
Water Heating	330,419	311,685	6%
Residential	6,100,841	5,563,511	10%
Public Authority MP2 Rate	201,087	196,600	2%
Public Authority MP1 Rate	58,081	57,449	1%
MP1 at 103% of rate	65,239	63,949	2%
Comm Hot Water Heat	2,467	2,073	19%
Comm Electric Heat and Air Conditioning	204,005	201,502	1%
Street Lighting	283,126		
Yard Lighting	101,978	95,766	6%
Primary Interruptible	415,185	430,971	-4%
Pri Industrial - P rates	10,369,428	10,749,927	-4%
Commercial Demand Primary Metered	201,977	209,520	-4%
Commercial Demand	11,524,001	11,655,430	-1%
Total	\$ 35,181,368	\$ 34,523,320	1.9%

Power Supply Costs by Class of Customers

- ▶ Power supply typically has two components
 - Demand related power costs
 - Energy related power costs
- ▶ Identifies if power costs vary by season and can be used to establish seasonal rates

Power Supply Costs

Customer Class	Summer		Winter	
	Demand	Energy	Demand	Energy
General Service	0.035	0.061	0.027	0.060
Senior Residential	0.026	0.061	0.014	0.060
Senior Water	0.016	0.061	0.011	0.060
Residential Space Heating	0.106	0.061	0.011	0.060
Water Heating	0.018	0.061	0.013	0.060
Residential	0.026	0.061	0.014	0.060
Public Authority MP2 Rate	0.020	0.061	0.017	0.060
Public Authority MP1 Rate	0.029	0.061	0.025	0.060
MP1 at 103% of rate	0.018	0.061	0.022	0.060
Comm Hot Water Heat	0.027	0.061	0.014	0.060
Comm Electric Heat and Air Conditionir	0.027	0.061	0.018	0.060
Primary Interruptible	13.93	0.058	8.51	0.059
Pri Industrial - P rates	11.70	0.058	6.72	0.059
Commercial Demand Primary Metered	12.35	0.058	6.46	0.059
Commercial Demand	9.74	0.061	5.39	0.060

Distribution Costs

- ▶ Identifies the cost to operate and maintain the distribution infrastructure
- ▶ Used to determine wheeling and standby rates
- ▶ Many public power systems investments are mostly or all distribution system costs

Distribution Costs

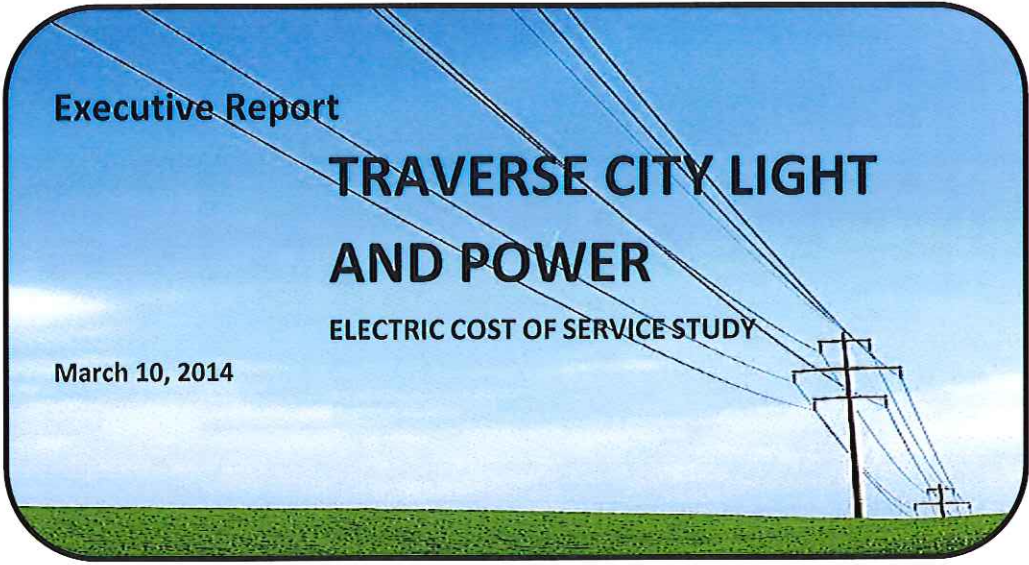
Customer Class	Monthly Customer Charge	Dist. Rate	Billing Basis
General Service	\$ 32.82	0.029	kWh
Senior Space	15.28	0.022	kWh
Senior Residential	15.28	0.022	kWh
Water Heating	15.28	0.02	kWh
Residential	15.28	0.02	kWh
Public Authority MP2 Rate	32.82	0.02	kWh
Public Authority MP1 Rate	32.82	0.03	kWh
MP1 at 103% of rate	32.82	0.03	kWh
Comm Hot Water Heat	32.82	0.02	kWh
Comm Electric Heat and Air Conditionin	32.82	0.02	kWh
Primary Interruptible	164.40	12.49	kW
Pri Industrial - P rates	164.40	6.13	kW
Commercial Demand Primary Metered	164.40	6.31	kW
Commercial Demand	75.58	6.22	kW

Monthly Customer Charge

- ▶ Designed to recover a portion of the fixed distribution costs of the utility such as:
 - Meter Costs
 - Meter Reading Costs
 - Billing Costs
 - Customer Service
 - Service Drop
 - Portion of Distribution System

Customer Charge Considerations

- ▶ Low income compared with low use
 - *At most utilities, low income customers tend to be higher than average users. A higher customer charge tends to benefit low income*
 - *Low customer charges result in higher energy charges.*
 - *Have to check demographics at your specific utility*
 - A higher customer charge typically results in lower overall charges for year round ratepayers
 - High charges for seasonal customers

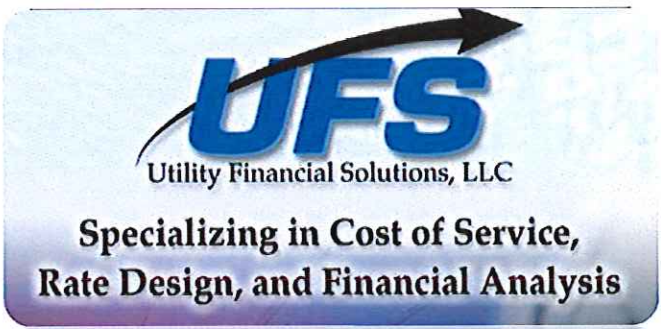


Executive Report

TRAVERSE CITY LIGHT AND POWER

ELECTRIC COST OF SERVICE STUDY

March 10, 2014



Utility Financial Solutions, LLC

**Specializing in Cost of Service,
Rate Design, and Financial Analysis**



March 10, 2014

Mr. Tim Arends
General Manager
Traverse City Light and Power
400 Boardman Avenue
Traverse City, MI 49684

Dear Mr. Arends:

We are pleased to present this executive summary report for an electric cost of service study for Traverse City Light and Power (TCLP). This report was prepared to provide TCLP with a comprehensive examination of its existing rate structure by an outside party.

The specific purpose of this report is to provide information to TCLP management and Board on unbundled rates and information on cost to serve by rate class. The test year was actual 2013 with rate implementation in 2015. The specific objectives of the study are as follows:

- 1) Identify cross-subsidies that may exist between rate classes
- 2) Identify the appropriate monthly customer charge for each customer class
- 3) Identify demand charges for classes served with demand meters
- 4) Identify energy charges for all customer classes
- 5) Unbundle rate components, including power supply, distribution, customer services, and transmission.
- 6) Guidance from the Board on movement toward cost of providing service to each class of customers.

This report includes results of the electric cost of service and unbundling study and recommendations on future rate designs. Specific recommendations included in this report are:

- 1) An allowance be provided to move customer classes closer to cost of service while limiting the rate impacts on any specific class
- 2) Recommendation that monthly customer charge variances between cost of service and current charges be addressed in future rate adjustments and the monthly customer charge difference phased in over an acceptable period of time

This report is intended for information and use by management and the Board for purposes stated above and is not intended to be used by anyone except the specified parties.

Sincerely,

A handwritten signature in black ink, appearing to read "Dawn Lund", is written over a light blue horizontal line.

Dawn Lund, Vice-President
Utility Financial Solutions, LLC

Section	Executive Summary	Page(s)
1	Introduction.....	1
2	Cost of Service and Financial Targets	3-8
3	Distribution and Transmission	9-10
4	Customer Related.....	12
5	Unbundling Process.....	13-16
6	Summary of Significant Assumptions.....	17
7	Summary of Recommendations.....	18
	Accountants Compilation Report.....	19

This report was prepared to provide TCLP with an electric cost of service study and a comprehensive examination of its existing rate structure by an outside party. The specific purposes of the rate study are identified below:

- 1) **Determine electric utility's revenue requirements for fiscal year 2015** The Electric Utility's revenue requirements were reconciled with the 2013 Audit.
- 2) **Identify cross-subsidies that may exist between rate classes.** Cross-subsidies exist when certain customer classes subsidize the electric costs of other customers. The rate study identifies if cross-subsidies exist and practical ways to reduce the subsidies. The cost of service study was completed using 2013 revenues and expenses.
- 3) **Unbundled electric rates.** The cost of providing electricity to customers consists of a number of components, including power supply, distribution, customer services, and transmission. Electric unbundling identifies the cost of each component to assist the utility in preparing for electric restructuring, understanding its cost structure and developing special rate forms for customers such as net metering rates, standby rates, and development of time of use rates.
- 4) **Identify the appropriate monthly customer charge for each customer class.** The monthly customer charge consists of fixed costs to service customers that do not vary based on the amount of electricity used.

TCLP retained Utility Financial Solutions to review the above items and make recommendations on the appropriate course of action. This report includes results of the electric cost of service and unbundling study.

Cost of Service Process Summary

Cost of Service Summary Results

The completed cost of service study identifies the costs of providing service to each class of customer and assists in design of electric rates for customers. The cost of service study consists of the following general steps:

- 1) Determine utility revenue requirements for 2015 using the electric department 2013 expenses and budget (2015 rate implementation)
- 2) Classify utility expenses into common cost pools
- 3) Allocate costs to customer classes based on the classes' contribution to utility expenses
- 4) Compare revenues received from each class to the cost of service

Table one below is a cost of service summary which compares projected costs to serve each customer class with projected revenues expected from each customer class. The "% change" column identifies the adjustment necessary to meet projected cost of service requirements.

Table One – Cost of Service Summary – Without Rate Adjustments

Customer Class	Cost of Service	Projected Revenues	% Change
General Service	\$ 4,160,883	\$ 4,067,955	2%
Senior Space	17,151	17,270	-1%
Senior Residential	992,979	759,742	31%
Senior Water	77,152	61,719	25%
Residential Space Heating	75,370	78,252	-4%
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Commercial Demand Primary Metered	201,977	209,520	-4%
Commercial Demand	11,524,001	11,655,430	-1%
Total	\$ 35,181,368	\$ 34,523,320	1.9%

TCBL's electric utility cost structure consists of power supply costs and distribution costs to operate and maintain local infrastructure. The study indicates an overall rate increase of 1.9% would be needed to meet cost to serve.

Utility Revenue Requirements

Revenue requirements for TCLP were projected for 2015 based on 2013 actual expenses. Revenues and expenses for 2013 were analyzed with adjustments made to actual expenses to reflect projected operating characteristics. Detailed descriptions of the methodology are included in the section "Summary of Significant Assumptions". The table below is a summary of the financial projection based on the following assumptions:

1. Inflation at 3%					
	Projected 2015	Projected 2016	Projected 2017	Projected 2018	Projected 2019
2. System Growth	0.02%	1.3%	1.4%	1.5%	1.6%

The table below is the projected financial statement for TCLP without rate adjustments. The projected operating income for 2015 is \$1.79 million and decreases to \$738,811 in 2019 below operating targets. Cash reserve projections are sufficient through 2018.

Table Two – Projected Financial Statements – Without Rate Adjustments

Fiscal Year	Projected Rate Adjustments	Projected Revenues	Projected Expenses	Adjusted Operating Income	Unreserved & Undesignated Cash & Investment Balance	Reserved Cash & Investment Balance	Capital Improvements	Bond Issues	Debt Coverage Ratio
2015	0.00%	\$ 37,224,972	\$ 35,437,939	\$ 1,787,033	\$ 5,480,448	\$ 9,525,000	\$ 9,072,000	-	n/a
2016	0.00%	36,919,545	35,493,300	1,426,245	3,898,947	9,525,000	5,755,000	-	n/a
2017	0.00%	38,110,010	36,950,319	1,159,691	2,453,401	9,525,000	5,560,000	-	n/a
2018	0.00%	38,219,712	37,251,708	968,004	1,274,717	9,525,000	5,300,000	-	n/a
2019	0.00%	38,874,005	38,135,194	738,811	(267,883)	9,525,000	5,650,000	-	n/a
Recommended Target in 2015				\$ 2,442,830	\$ 10,449,846				1.40
Recommended Target in 2019				\$ 3,155,310	\$ 10,857,653				1.40

1. Financial projections should be dynamic and updated on a regular basis as part of the annual budget process.
2. Additional assumptions used in development of financial projections are included in the summary of significant assumptions section on page 17 of this report.

DEVELOPMENT OF RECOMMENDED RATE TRACK:

When evaluating rates to charge customers, three factors must be considered:

1. Future Debt Coverage Ratio's to meet bond covenants
2. Minimum Cash Reserves the utility should hold in reserve
3. Optimal (Target) operating Income to help ensure current customers are charged properly for infrastructure used to provide electricity

Each of these factors is discussed below:

- 1) **Debt Coverage Ratio** – TCLP currently does not have any debt. The following is for informational purposes should debt be issued in the future. Debt coverage ratios are mandated by covenants and established in bond ordinances and must be maintained to ensure the utility maintains its bond rating and has the capacity to issue additional revenue bonds. Revenue bond requirements typically require cash generated from operations exceed 1.20 times the debt payments.
 - a. Due to fluctuations in sales, mainly the result of weather or the economy, a safety factor of 0.20 is recommended resulting in a minimum target of 1.40.
 - b. Maintaining debt coverage ratios is critical to the utility's bond rating, future financial health, and helps keep interest costs lower in future years.
 - c. Failure to meet debt coverage ratio requirements in bond ordinances results in default on the debt.

Utility Revenue Requirements

2) **Minimum Cash Reserve Target** - To help ensure timely completion of capital improvements and enable the utility to meet requirements for large unexpected expenditures, a minimum cash reserve policy should be established. Minimum cash reserves attempts to quantify the minimum amount of cash the utility should keep in reserve, actual cash reserves may vary substantially above the minimum and is dependent on the life cycle of assets that are currently in service. The methodology used in this report is based on certain assumptions related to percent of operation and maintenance, rate base, capital improvements, and debt service. The establishment of minimum cash reserves should consider a number factors including:

- **Working Capital Lag** - Timing differences between when expenses are incurred and revenues received from customers. Establishing a minimum cash reserve helps to ensure cash exists to pay expenses in a timely manner.
- **Investment in assets** – Catastrophic events may occur that require substantial amounts of cash reserves to replace damaged assets. Some examples of catastrophic events include ice storms, earthquakes, wind storms, floods, or tornadoes. Many of these catastrophic events may allow the utility to recover the cost of damages from FEMA; however FEMA reimbursements can take between 6 months to 2 years to recover. The utility should ensure adequate cash reserves exist to replace the assets in a timely fashion. The minimum reserve levels are often combined with emergency funding from banks or bonding agencies.
- **Annual debt service** – Debt service payments do not occur evenly throughout the year and often occurs at periodic times typically every six months. The utility has to ensure adequate cash reserves exist to fund the debt service payment when the payment is due.
- **Capital improvement program** – Some capital improvements are funded through bond issuances and some through cash reserves. The establishment of a minimum cash reserve level helps to ensure timely replacement or construction of assets.

The minimum recommended cash reserve for TCLP is \$10.5 million. TCLP has a combined cash balance of \$14.9 million in 2015 and decreases to \$9.3 million in 2019. Table four provides the minimum cash reserve calculation.

Table Four – Minimum Cash Reserves – Fiscal Year Ending 2015 – 2019

	Percent Allocated	Projected 2015	Projected 2016	Projected 2017	Projected 2018	Projected 2019
Operation & Maintenance (Less Depreciation Expense & Power Supply)	11%	\$ 871,541	\$ 910,328	\$ 938,112	\$ 960,343	\$ 986,337
Power Supply	9%	2,307,520	2,260,446	2,349,811	2,339,554	2,377,881
Historical Rate Base	1%	763,384	820,934	876,534	929,534	986,034
Current Portion of Debt Service	0%	-	-	-	-	-
Five Year Capital Improvements - Net of Bond Proceeds	20%	6,507,400	6,507,400	6,507,400	6,507,400	6,507,400
Minimum Cash Reserve Levels		\$ 10,449,846	\$ 10,499,108	\$ 10,671,857	\$ 10,736,832	\$ 10,857,653
Restricted Reserves		\$ 9,525,000	\$ 9,525,000	\$ 9,525,000	\$ 9,525,000	\$ 9,525,000
Unrestricted Reserves		\$ 5,480,448	\$ 3,898,947	\$ 2,453,401	\$ 1,274,717	\$ (267,883)

Cash reserves are sufficient through 2018 without rate adjustments.

Utility Revenue Requirements

- 3) **Optimal operating income targets** - The optimal target for setting rates is the establishment of a target operating income to help ensure the following:
- a. Funding of depreciation expense
 - b. Adequate rate of return on investment to help ensure current customers are paying their fair share of the use of the infrastructure and not deferring the charge to future generations
 - c. Funding of interest expense
 - d. Funding inflationary increase on assets

As improvements are made to the system, the optimal operating income target will increase unless annual depreciation expense is greater than yearly capital improvements. The target established for 2015 is \$2.4 million and increases to \$3.1 million. The current rate of return is 5.0%. A typical municipal return is 5.0% to 7%.

Table Five - Optimal Operating Income Targets Compared to Projected

	Percent Allocated	Projected 2015	Projected 2016	Projected 2017	Projected 2018	Projected 2019
Interest Expense on Debt	0.0%	\$ -	\$ -	\$ -	\$ -	\$ -
System Equity	4.0%	2,442,830	2,626,990	2,804,910	2,974,510	3,155,310
Target Operating Income		\$ 2,442,830	\$ 2,626,990	\$ 2,804,910	\$ 2,974,510	\$ 3,155,310
Projected Adjusted Operating Income		1,787,033	1,426,245	1,159,691	968,004	738,811
Rate of Return in %		5.0%	5.0%	5.1%	5.2%	5.3%

TCLP is projected to fall below optimal targeted operating income levels throughout the projection. A 1.5% rate adjustment is recommended for 2015 and inflationary increases every other year. The projection should be updated yearly with the budget process. Costs may come in higher or lower than anticipated and change the recommended rate track.

Utility Revenue Requirements

RECOMMENDED RATE TRACK

TBLP revenues are currently not meeting its cost to serve customers. We are recommending a small increase of 1.5% in 2015 and inflationary increases every other year to maintain financial targets. The financial projection and rate track will need to be reviewed as expenses and capital improvements materialize.

Table Eight is a summary of the financial results with the recommended rate adjustments.

Table Eight – Recommended Rate Adjustments

Fiscal Year	Projected Rate Adjustments	Projected Revenues	Projected Expenses	Adjusted Operating Income	Unreserved & Undesignated Cash & Investment Balance	Reserved Cash & Investment Balance	Capital Improvements	Bond Issues	Debt Coverage Ratio
2015	1.50%	\$ 37,746,155	\$ 35,437,939	\$ 2,308,216	\$ 6,001,632	\$ 9,525,000	\$ 9,072,000	-	n/a
2016	0.00%	37,447,333	35,520,745	1,926,588	4,925,685	9,525,000	5,755,000	-	n/a
2017	2.50%	39,315,962	37,013,028	2,302,933	4,633,648	9,525,000	5,560,000	-	n/a
2018	0.00%	39,443,745	37,315,357	2,128,388	4,637,150	9,525,000	5,300,000	-	n/a
2019	2.50%	40,825,969	38,236,696	2,589,273	4,978,636	9,525,000	5,650,000	-	n/a
Recommended Target in 2015				\$ 2,442,830		\$ 10,449,846			1.40
Recommended Target in 2019				\$ 3,155,310		\$ 10,868,818			1.40

COST OF SERVICE RESULTS

Table Two below shows the average cost of service per kWh and compares that cost to the average revenue per kWh for each customer class. The table is sorted from lowest to highest based on average cost of service.

Table Two - Average Cost per kWh compared with Average Revenue per kWh

Customer Class	Cost of Service	Projected Revenues
Primary Interruptible	0.081	0.084
Pri Industrial - P rates	0.088	0.092
Commercial Demand Primary Metered	0.102	0.106
Public Authority MP2 Rate	0.103	0.101
Residential Space Heating	0.106	0.110
Senior Space	0.106	0.107
Commercial Demand	0.107	0.108
Public Authority MP1 Rate	0.116	0.115
MP1 at 103% of rate	0.116	0.114
Comm Electric Heat and Air Conditioning	0.119	0.118
Water Heating	0.122	0.115
Senior Water	0.126	0.101
Residential	0.130	0.118
Senior Residential	0.139	0.106
General Service	0.143	0.140
Yard Lighting	0.150	0.141
Comm Hot Water Heat	0.151	0.127
Street Lighting	0.213	-

DISTRIBUTION RATES

Separation of distribution cost helps identify distribution charges and the fixed monthly customer charge for customer classes. This helps to ensure TCLP recovers its operational costs. Distribution rates include separation of the following costs:

- 1) Operation and maintenance of distribution & transmission system, Contributions to City, Customer service, Customer accounting, Meter reading, Billing, Meter operation & maintenance, Administrative expenses

The distribution rates consist of two components:

- 1) Monthly customer charge to recover the costs of meter reading, billing, customer service, and a portion of maintenance and operations of the distribution system.
- 2) Distribution rate based on billing parameter, (KW or kWh) to recover the cost to operate and maintain the distribution system. The table below identifies the cost-based distribution rates for customer classes.

Table Three– Distribution Rates by Customer Class

Customer Class	Monthly Customer Charge	Dist. Rate	Billing Basis
General Service	\$ 32.82	0.029	kWh
Senior Space	15.28	0.022	kWh
Senior Residential	15.28	0.022	kWh
Senior Water	15.28	0.02	kWh
Residential Space Heating	15.28	0.02	kWh
Water Heating	15.28	0.02	kWh
Residential	15.28	0.02	kWh
Public Authority MP2 Rate	32.82	0.02	kWh
Public Authority MP1 Rate	32.82	0.03	kWh
MP1 at 103% of rate	32.82	0.03	kWh
Comm Hot Water Heat	32.82	0.02	kWh
Comm Electric Heat and Air Conditioning	32.82	0.02	kWh
Street Lighting	9.24	0.15	kWh
Yard Lighting	4.62	0.09	kWh
Primary Interruptible	164.40	12.49	KW
Pri Industrial - P rates	164.40	6.13	KW
Commercial Demand Primary Metered	164.40	6.31	KW
Commercial Demand	75.58	6.22	KW

Tables Three, (Distribution Costs) Four (Power Supply Costs) and Five (Total Costs) are cost of service rates and are not recommended for implementation. This information is used during the rate design process which considers a number of factors including but not limited to the following:

- 1) Cost of service results
- 2) Energy conservation
- 3) Social issues
- 4) Economic development
- 5) Accurate price signals to customers

Delivery of electricity consists of many components that bring electricity from the power supply facilities to the communities and eventually into customer facilities. The facilities consist of four major components: transmission, distribution, customer-related services, and administration. Following are general descriptions of each of these facilities and the sub-breakdowns within each category.

Transmission

The transmission system is comprised of four types of subsystems that operate together:

- 1) Backbone and inter-tie transmission facilities are the network of high voltage facilities through which a utility’s major production sources are integrated.
- 2) Generation set-up facilities are the substations through which power is transformed from a utility’s generation voltages to its various transmission voltage
- 3) Sub-transmission plant consists of lower voltage facilities to transfer electric energy from convenient points on a utility’s backbone system to its distribution system
- 4) Radial transmission facilities are those that are not networked with other transmission lines but are used to serve specific loads directly.

Terminology of Cost of Service

FUNCTIONALIZATION – Cost data arranged by functional category (e.g. power supply, transmission, distribution)

CLASSIFICATION – Assignment of functionalized costs to cost components (e.g. demand, energy and customer related).

ALLOCATION – Allocating classified costs to each class of service based on each class’s contribution to that specific cost component.

DEMAND COSTS – Costs that vary with the maximum or peak usage. Measured in kilowatts (kW)

ENERGY COSTS – Costs that vary over an extended period of time. Measured in kilowatt-hours (kWh)

CUSTOMER COSTS – Costs that vary with the number of customers on the system, e.g. metering costs.

DIRECT ASSIGNMENT – Costs identified as belonging to a specific customer or group of customers.

Distribution System

The distribution facilities connect the customer with the transmission grid to provide the customer with access to the electrical power that has been generated and transmitted. The distribution plant includes substations, primary and secondary conductors, poles, and line transformers that are jointly used and in the public right-of-way.

Substations typically separate the distribution plant from the transmission system. The substation power transformer “steps down” the voltage to a level that is more practical to install on and under City streets.

Distribution system provides primary circuits with voltages between 12.47 kV and 4.16 kV. Secondary circuits are 480 volts and less.

Distribution Customer Types

Sub-transmission customers are served directly from the substation feeder and bypass both the secondary and primary distribution lines. The charges for this type of customer should reflect the cost of the substation and not include the cost of primary or secondary line charges.

Primary customers are typically referred to as customers who have purchased, owned, and maintained their own transformers that convert the voltage to the secondary voltage level. The rates for these customers should reflect the cost of substations and the cost of primary distribution lines and not include the cost of secondary line extensions.

Secondary customers have the services provided by the utilities directly into their facilities. The utility provides the customer with the transformer and the connection on the customers’ facilities.

Customer-Related Services

Certain administrative-type services are necessary to ensure customers are provided service connections and disconnections in a timely manner and the facilities are in place to read meters and bill for customer usages. These services typically consist of the following components:

- 1) Customer Services – The cost of providing personnel to assist customers with questions and dispatch personnel to connect and disconnect meters.
- 2) Billing and Collections – The cost of billing and collections personnel, postage, and supplies.
- 3) Meter Reading – The cost of reading customers' meters.
- 4) Meter Operation and Maintenance – The cost of installing and maintaining customer meters.

Administrative Services

These costs are sometimes referred to as overhead costs and relate to functions that cannot be directly-attributed to any service. These costs are spread to the other services through an allocator such as labor, expenses, or total rate base. These costs may consist of property insurance, and wages for higher level management of the utility.

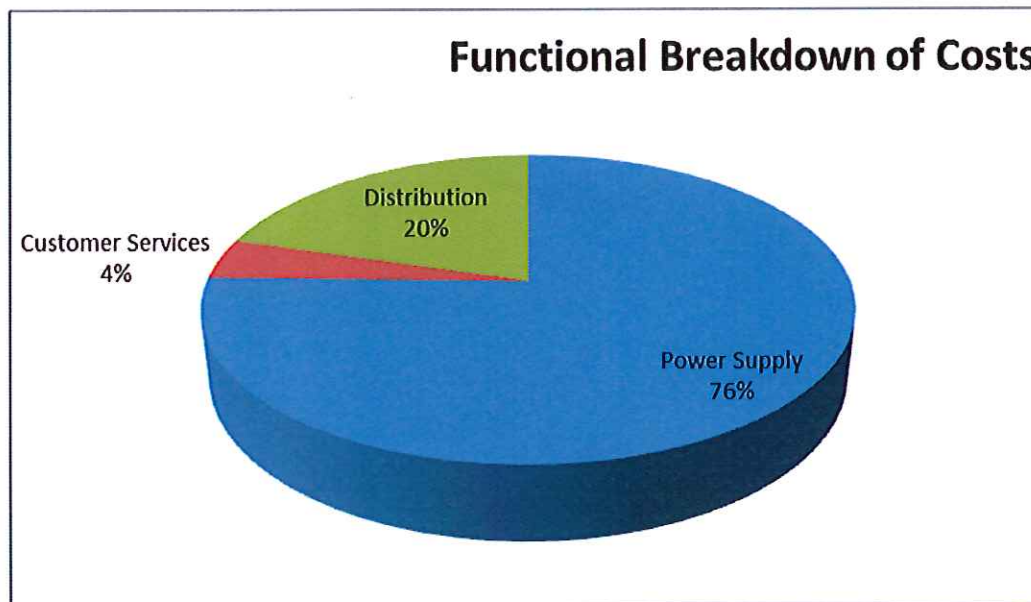
System Losses

As energy moves through each component of the transmission and distribution system, some of the power is lost and cannot be sold to customers. Losses vary based on time of day and season. Typically, as system usage increases or ambient temperature increases, the percentages of losses that occur also increase. These losses are recovered from distribution customers through an analysis of the peak losses that occur in the system

Unbundling Process

The cost of power supply, distribution, and customer services are identified as part of the unbundling process and are the first step in determining unbundled charges to customers. The total revenue requirements of \$35.4 million are separated into four categories identified in the graph below.

Graph One – Breakdown of TCLP Cost Structure

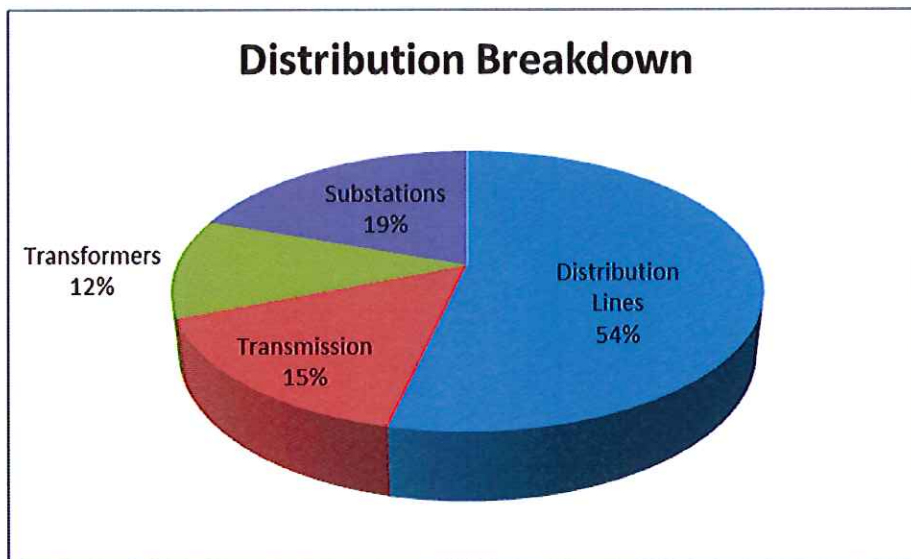


TCLP is projected to expend 76% of its total costs toward power supply and purchase power costs. Distribution-related costs are 20% and customer service amounts to 4%. These components are broken down into each of the subcomponents and are identified in the following sections.

Functional Breakdown of Costs

As stated earlier, distribution and customer charges consist of a number of different components; total distribution-related costs of \$7.2 million for 2013 are broken down into the main components listed below, substations, transformers, transmission, and distribution lines, meter O&M and customer line extensions.

Graph Two – Breakdown of Distribution Costs



Each of these components are allocated to customer groups based on certain factors established in the study. These factors are based on the efficiency of each customer class and the time of day or the season the electricity is used. Other factors are also considered, such as the length of line extensions to reach certain customer classes. A complete list of allocators is included in the detailed section of this report.

Power Supply Cost Breakdown

The table below identifies the average cost of providing power supply to customers of TCLP.

Table Four Power Supply Cost by Customer Class (Cost of Service Rates – Not Recommended)

Customer Class	Demand	Billing Basis	Energy	Billing Basis
General Service	0.033	kWh	0.056	kWh
Senior Space	0.013	kWh	0.059	kWh
Senior Residential	0.023	kWh	0.059	kWh
Senior Water	0.015	kWh	0.061	kWh
Residential Space Heating	0.014	kWh	0.059	kWh
Water Heating	0.015	kWh	0.063	kWh
Residential	0.018	kWh	0.063	kWh
Public Authority MP2 Rate	0.017	kWh	0.061	kWh
Public Authority MP1 Rate	0.023	kWh	0.060	kWh
MP1 at 103% of rate	0.021	kWh	0.061	kWh
Comm Hot Water Heat	0.019	kWh	0.062	kWh
Comm Electric Heat and Air Conditioning	0.022	kWh	0.063	kWh
Street Lighting	-	kWh	0.063	kWh
Yard Lighting	-	kWh	0.063	kWh
Primary Interruptible	9.90	kW	0.058	kWh
Pri Industrial - P rates	8.39	kW	0.058	kWh
Commercial Demand Primary Metered	7.84	kW	0.058	kWh
Commercial Demand	6.76	kW	0.063	kWh

The study assumed additional fuel costs would be recovered through a Power Cost Adjustment (PCA) charged to customers.

Combined Cost Summary

The table below identifies the cost of service rates for each customer class. Charging these rates would directly match the cost of providing service to customers identified in this study.

Table Five – Total Costs by Customer Class (Cost of Service Rates – Not Recommended)

Customer Class	Current Customer Charge	Customer Charge	Demand	Energy
General Service	\$ 10.25	\$ 32.82		0.119
Senior Space	3.75	15.28		0.094
Senior Residential	3.75	15.28		0.104
Senior Water	3.75	15.28		0.093
Residential Space Heating	4.75	15.28		0.093
Water Heating	4.75	15.28		0.097
Residential	4.75	15.28		0.103
Public Authority MP2 Rate	20.00	32.82		0.102
Public Authority MP1 Rate	16.00	32.82		0.109
MP1 at 103% of rate	16.00	32.82		0.116
Comm Hot Water Heat	10.25	32.82		0.103
Comm Electric Heat and Air Conditioning	10.25	32.82		0.111
Street Lighting		9.24		0.213
Yard Lighting		4.62		0.150
Primary Interruptible	40.00	164.40	22.38	0.058
Pri Industrial - P rates	40.00	164.40	14.52	0.058
Commercial Demand Primary Metered	11.00	164.40	14.15	0.058
Commercial Demand	10.00	75.58	12.98	0.063

Significant Assumptions

This section outlines the procedures used to develop the cost of service and unbundling study for Traverse City Light and Power

Forecasted Operating Expenses

Forecasted expenses were based on 2013 and inflation and other known changes. The table below is a summary of the expenses used in the analysis.

Table Twelve – Actual and Projected Operating Expenses for 2015-2019

	Projected 2015	Projected 2016	Projected 2017	Projected 2018	Projected 2019
Generation	25,337,795	24,840,063	25,822,101	25,709,389	26,130,563
Distribution	3,627,433	3,736,256	3,848,343	3,963,794	4,082,708
Transmission	332,866	342,852	353,137	363,731	374,643
Customer Accounts Expense	548,398	564,850	581,796	599,249	617,227
Public Service	683,058	703,549	724,656	746,396	768,787
Administrative and General	920,183	947,789	976,223	1,005,509	1,035,675
Other	58,830	60,594	62,412	64,285	66,213
City Fee	1,782,046	1,947,261	2,044,430	2,051,075	2,122,950
Depreciation Expense	2,147,330	2,377,530	2,599,930	2,811,930	3,037,930
Operating Expenses	\$ 35,437,939	\$ 35,520,745	\$ 37,013,028	\$ 37,315,357	\$ 38,236,696

Load Data

Load data is one of the most critical components of a cost of service study. Information from the billing statistics combined with information from like utilities were used to determine the usage patterns of each customer class.

KWh Sales Forecast

The kWh sales forecast is based on 2013 actuals adjusted for growth throughout the projection as indicated below.

	Projected 2015	Projected 2016	Projected 2017	Projected 2018	Projected 2019
System Growth	0.02%	1.3%	1.4%	1.5%	1.6%

System Loss Factors

Losses occurring from the transmission and distribution of electricity can vary from year to year depending upon weather and system loading.

Revenue Forecast

The revenue forecast was based on 2013 usages adjusted for growth rate assumptions and changes in purchased power costs through the PCA.

Recommendations

1. Traverse City Light and Power revenues are not currently meeting its cost to serve customers. We are recommending a small increase of 1.5% in 2015 and inflationary increases every other year to maintain financial targets. The financial projection and rate track will need to be reviewed as expenses and capital improvements materialize. Costs and revenues may come in higher or lower than anticipated and change the recommended rate track.

Fiscal Year	Projected Rate Adjustments	Projected Revenues	Projected Expenses	Adjusted Operating Income	Unreserved & Undesignated Cash & Investment Balance	Reserved Cash & Investment Balance	Capital Improvements	Bond Issues	Debt Coverage Ratio
2015	1.50%	\$ 37,746,155	\$ 35,437,939	\$ 2,308,216	\$ 6,001,632	\$ 9,525,000	\$ 9,072,000	-	n/a
2016	0.00%	37,447,333	35,520,745	1,926,588	4,925,685	9,525,000	5,755,000	-	n/a
2017	2.50%	39,315,962	37,013,028	2,302,933	4,633,648	9,525,000	5,560,000	-	n/a
2018	0.00%	39,443,745	37,315,357	2,128,388	4,637,150	9,525,000	5,300,000	-	n/a
2019	2.50%	40,825,969	38,236,696	2,589,273	4,978,636	9,525,000	5,650,000	-	n/a
Recommended Target in 2015				\$ 2,442,830	\$ 10,449,846				1.40
Recommended Target in 2019				\$ 3,155,310	\$ 10,868,818				1.40

2. The study identified some customer classes are paying above cost of service and some below cost of service. It is recommended rates be designed with a plus or minus 2.0% bandwidth for each customer class. For example, on average, with a rate increase of 1.5%, no customer class would see an increase higher than 3.5% and no customer would see an increase lower than -0.5%. The table below would be used to help guide which customers see a higher or lower increase than the overall approved increase.

Customer Class	Cost of Service	Projected Revenues	% Change
General Service	\$ 4,160,883	\$ 4,067,955	2%
Senior Space	17,151	17,270	-1%
Senior Residential	992,979	759,742	31%
Senior Water	77,152	61,719	25%
Residential Space Heating	75,370	78,252	-4%
Water Heating	330,419	311,685	6%
Residential	6,100,841	5,563,511	10%
Public Authority MP2 Rate	201,087	196,600	2%
Public Authority MP1 Rate	58,081	57,449	1%
MP1 at 103% of rate	65,239	63,949	2%
Comm Hot Water Heat	2,467	2,073	19%
Comm Electric Heat and Air Conditioning	204,005	201,502	1%
Street Lighting	283,126		
Yard Lighting	101,978	95,766	6%
Primary Interruptible	415,185	430,971	-4%
Pri Industrial - P rates	10,369,428	10,749,927	-4%
Commercial Demand Primary Metered	201,977	209,520	-4%
Commercial Demand	11,524,001	11,655,430	-1%
Total	\$ 35,181,368	\$ 34,523,320	1.9%

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ACCOUNTANTS' COMPILATION REPORT

Traverse City Light and Power

The accompanying forecasted statements of revenues and expenses of Traverse City Light and Power were compiled for the year ending June 30, 2013 in accordance with guidelines established by the American Institute of Certified Public Accountants.

The purpose of this report is to assist management in forecasting revenue requirements and determining the cost to service each customer class. This report should not be used for any other purpose.

A compilation is limited to presenting, in the form of a forecast; information represented by management and does not include evaluation of support for any assumptions used in projecting revenue requirements. We have not audited the forecast and, accordingly, do not express an opinion or any other form of assurance on the statements or assumptions accompanying this report.

Differences between forecasted and actual results will occur since some assumptions may not materialize and events and circumstances may occur that were not anticipated. Some of these variations may be material. Utility Financial Solutions has no responsibility to update this report after the date of this report.

This report is intended for information and use by TCLP and management for the purposes stated above. This report is not intended to be used by anyone except the specified parties.

UTILITY FINANCIAL SOLUTIONS

Mark Beauchamp, CPA, CMA, MBA
Holland, MI
March 10, 2014