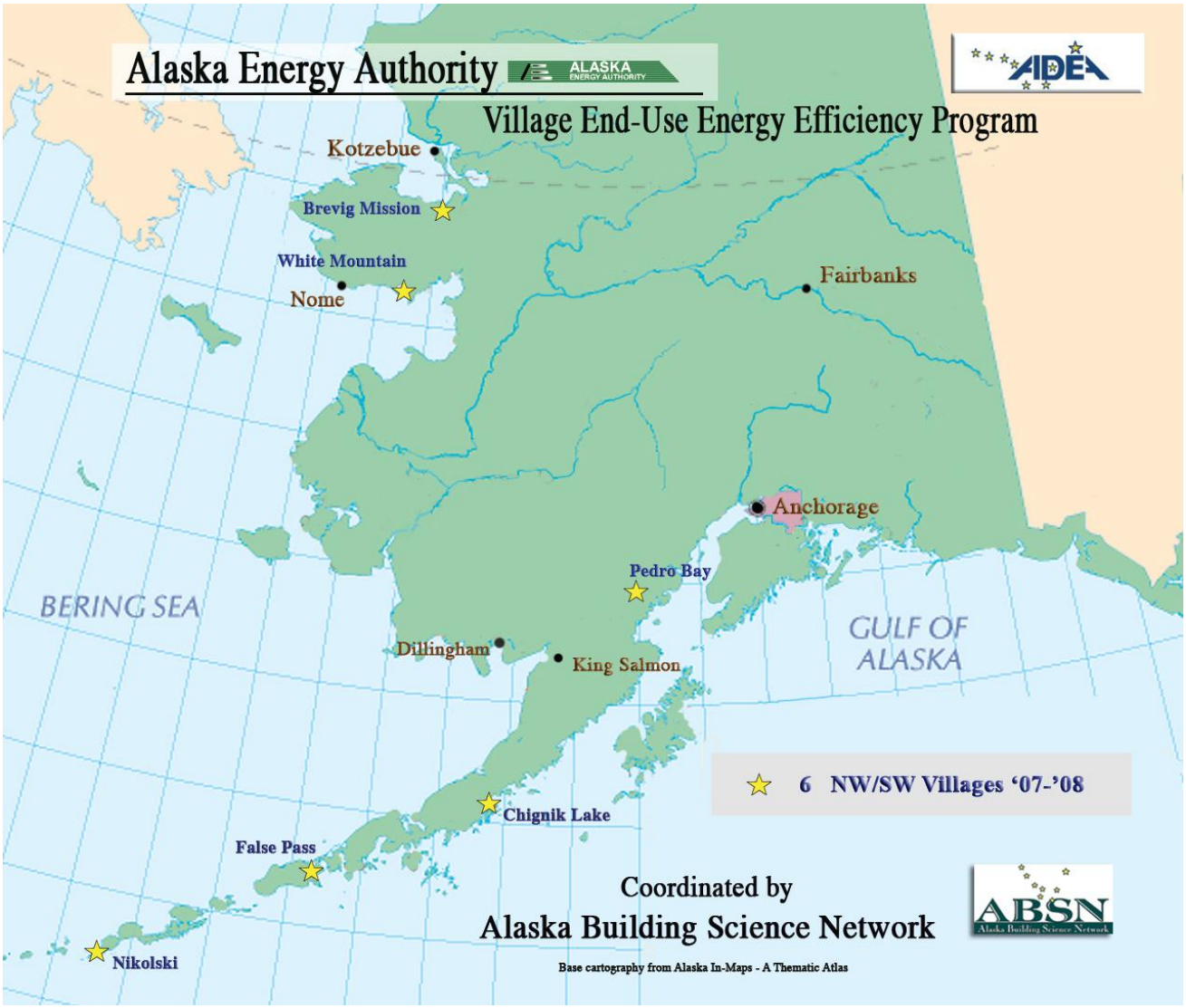
FINAL REPORT

AEA Grant # 2195225



Northwest / Southwest Region
2007 – 2008

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Village End Use Energy Efficiency Measures Program '07 – '08

AEA Grant # 2195225 Administered by Alaska Building Science Network

Final Report - Executive Summary: Northwest – Southwest Region

- By ABSN Project Manager Geoff Butler, March, 2009

From Jan. 2007 – Jan. 2009 the following 6 rural Alaska villages received energy efficiency upgrades to community buildings:

Brevig Mission, Chignik Lake, False Pass, Nikolski, Pedro Bay, White Mountain

Total program grant funds: $226,650 Grant funds averaged per village: $37,775

The goal of these grant projects is to facilitate energy efficiency upgrades to community buildings that deliver the greatest energy savings at the fastest payback rate on grant funds. Energy efficient lighting upgrades are the first measures undertaken. ABSN provides project development, coordination, training, technical assistance, materials and logistical support to facilitate these projects. For this grant cycle, to advance technology transfer and provide rural employment and skills training, we partnered directly with 20 rural village entities region-wide and provided lighting retrofit training to approximately 30 local maintenance staff who completed lighting and other energy upgrades in their buildings. Region-wide, 48 community buildings and 16 teacher-housing units operated by rural school districts received energy efficiency improvements.

At the inception of these grants in 2002, original energy audits for these projects estimated light fixture (replacement) at a cost of $355 per fixture. Within this scenario, the 1,038 linear fluorescent light fixtures retrofitted region-wide, alone, would have cost $368,490 to complete. With ABSN's methods, when we deduct materials costs of heating measures, T5 and CFL lighting materials grant-wide, our cost for linear fluorescent retrofits is $176 per fixture. ABSN's approach of partnering with local city, tribal governments, village corporations and rural school districts, coupled with the substantial in-kind contributions arising from these partnerships - facilitated the lighting upgrades and allowed us to pursue additional energy savings measures. ABSN's approach provides skills training and employment for rural maintenance staff all at reduced costs compared with of original audit estimates for these projects.

Primary Accomplishments of this Grant Region-wide for total budget of $226,650:

- 1,038 linear fluorescent lighting retrofits
- 475 Compact fluorescent light bulb installations
- Three T5 light fixture upgrades in school gym and multi-purpose facilities
- $ 34,400 grant funds spent on additional energy efficiency measures beyond lighting
  - Brevig Mission – installed two EK3 low-mass boilers in BSSD teacher housing and storage building – all in-kind labor and logistics.
  - Chignik Lake: Air sealing and an addition of R-30 attic insulation in SUB building
  - Nikolski: Will contribute primary materials for Nikolski Community Center heat recovery project.
  - Pedro Bay: Completed attic air sealing and insulation measures in the PHOB Tribal Building.
  - 18 programmable thermostats installed region wide for an additional 5-10% in heating fuel savings.
- Acquired $ 51,375.39 in matching grant resources – extending the capacity of AEA grant funding by 22.6%

Grant funds payback and fuel saving measures

Savings from heating measures and corresponding grant expenditures are not included in payback calculations. Our region-wide payback estimate of 2.37 years* on total grant funds includes spending for all lighting and heating measures, but it does not account for any savings from the heating measures. In other words, our payback figures absorb the full cost of fuel savings measures, but do not reflect any savings resulting from them. The heating measures will result in measurable fuel savings, which we currently do not have data to calculate. If it was possible to calculate fuel savings from the heating measures we are confident it would measurably reduce payback time on total grant funds.

Region-Wide Lighting Upgrade Summary

For all linear fluorescent, compact fluorescent bulb and T5 lighting retrofits and installations:

- Pre-retrofit energy use for all lighting: 152.93 kW
- Post-retrofit energy use for all lighting: 76.91 kW
- Energy savings from all lighting upgrades: 76.02 kW
- **Pre-retrofit to post retrofit energy reduction: 50 %**

- **Estimated Annual Savings Range:**

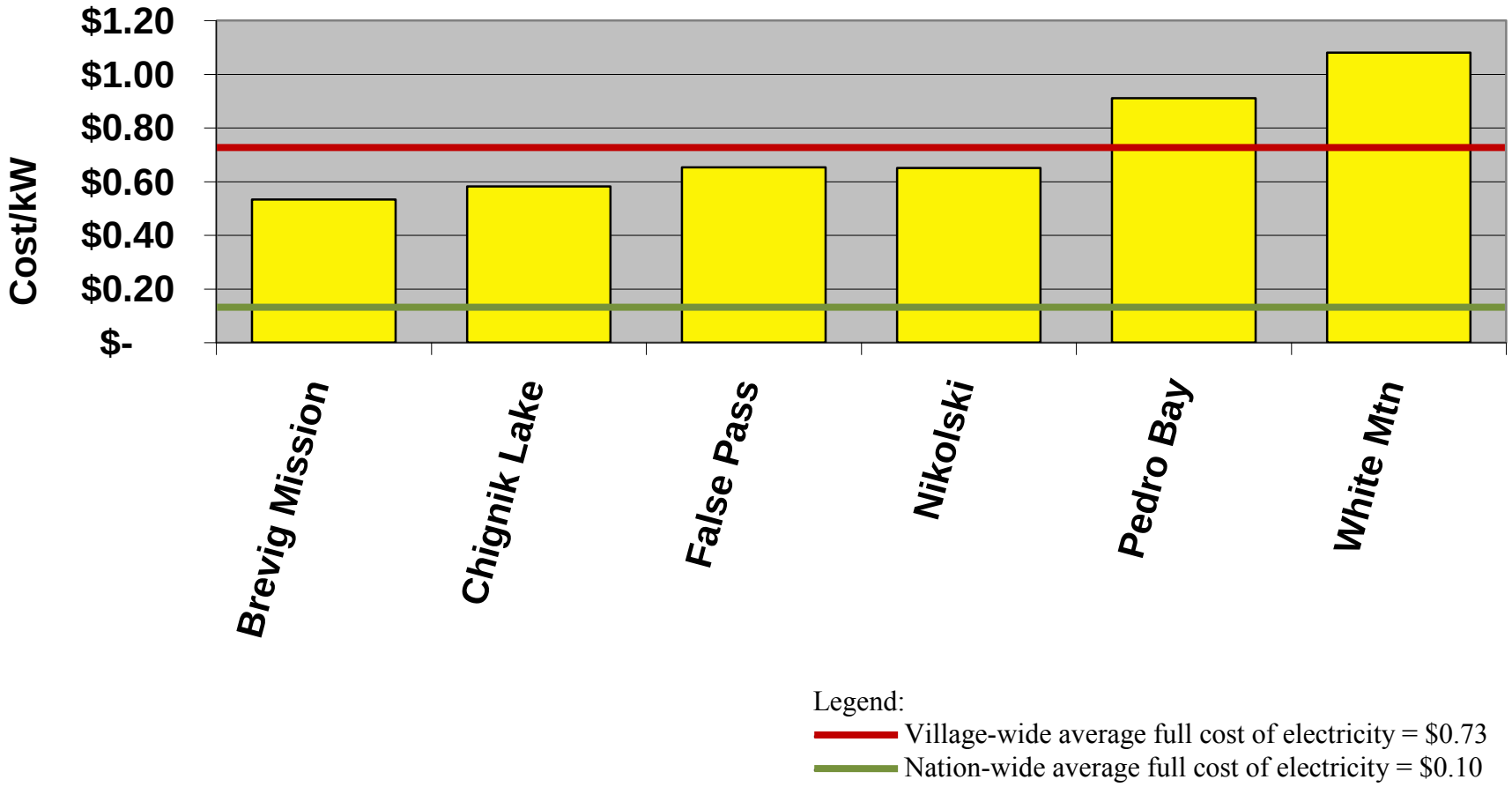
Hours Per Day / 250 Days Per Year	Electrical Savings	Avoided Diesel Use (gallons)	Avoided Diesel Costs	Payback Est. (yrs)
4 Hours	$ 54,601	6,589	$ 19,126	4.15
7 Hours	$ 95,551	11,531	$ 33,471	2.37
10 Hours	$ 136,501	16,473	$ 47,816	1.66

- Total grant funds for all energy efficiency measures: $ 226,650
- Simple mean payback (All grant funds, but accounting for lighting savings only) 2.37 Years

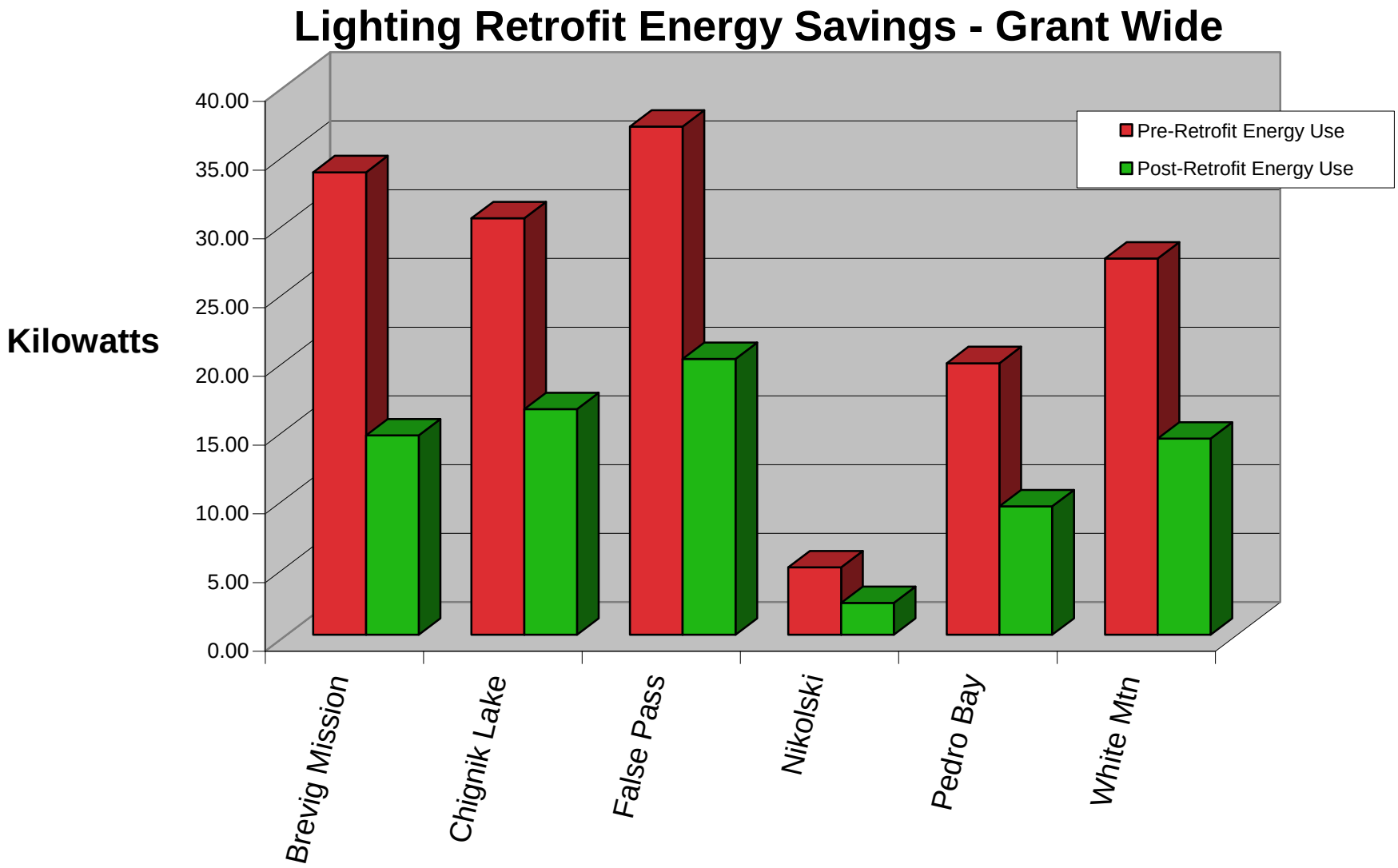
Additional Energy Efficiency Measures (Region-wide grant funding: $34,400)

After completing lighting measures with good payback, we dedicated remaining grant funds to fuel saving measures and heating system energy efficiency. Our organizational focus in energy efficiency and northern building science places us in the unique position of being able to dovetail similar objectives from different projects providing a win-win benefit to the VEUEEM grants. These and many other in-kind resources enabled us to go beyond the originally conceived scope of work and substantially expand the capacity of these energy efficiency projects.

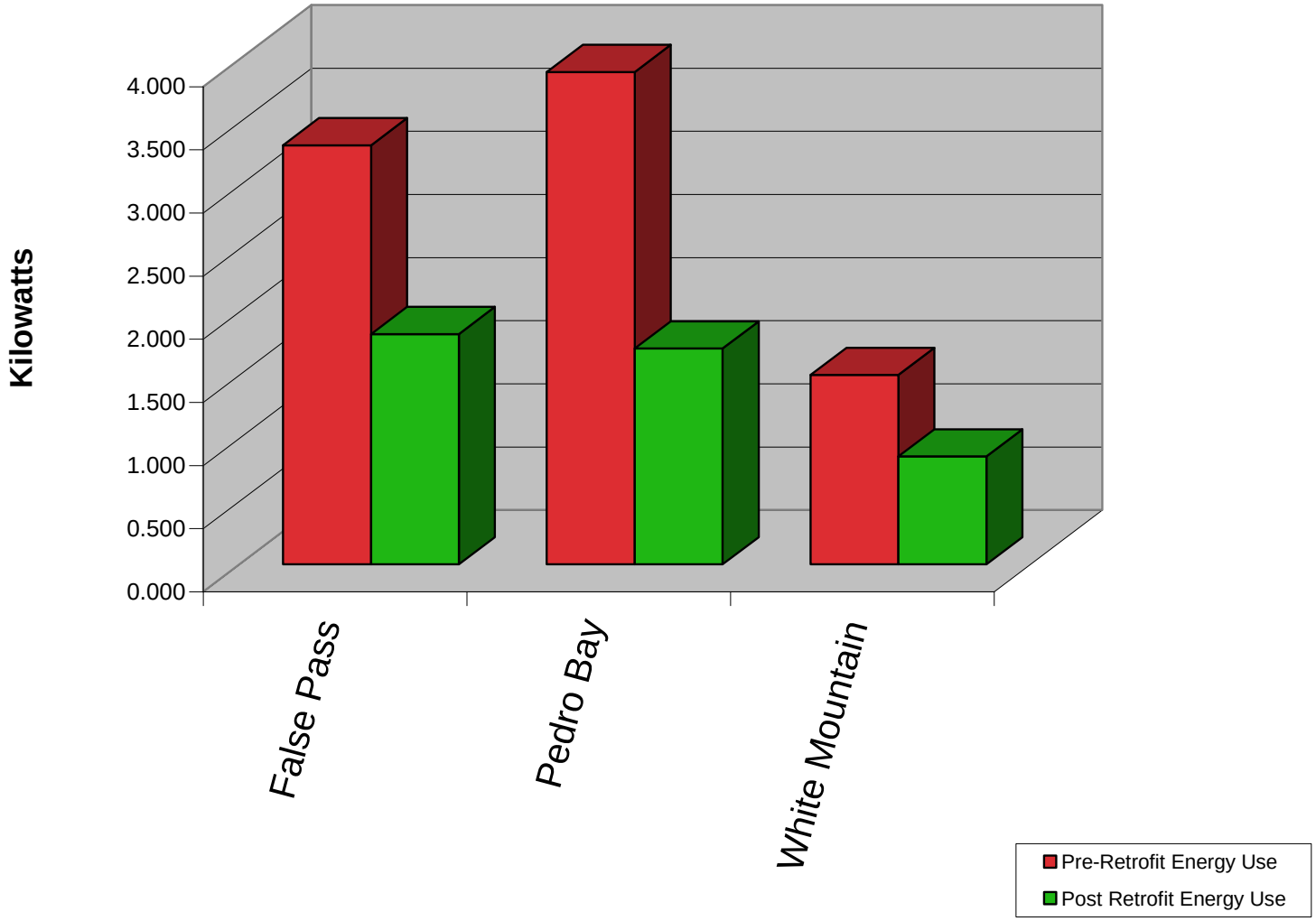
Full Cost of Electricity '07-'08 Villages



AEA Village End Use Energy Efficiency Progam '07-'08


Lighting Retrofit Energy Savings - Grant Wide
Kilowatts
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Pre-Retrofit Energy Use
Post-Retrofit Energy Use
Brevig Mission
Chignik Lake
False Pass
Nikolski
Pedro Bay
White Mtn
AEA Village End Use Energy Efficiency Program '07-'08

T5 Gym & Common Area Lighting Upgrades



AEA Village End Use Energy Efficiency Program
'07-'08

AEA LIGHTING RETROFIT PROJECT - Summary of Savings For '07 - '08 Grant Activities

With Building Use Estimates of 7 hrs / day, 250 days/year:

Electric Rates are full rates including fuel surcharges and excluding PCE deductions. Rates are current Small Commercial (1-700 kWh), acquired from rural utilities in late fall of 2008.

VILLAGES	Pre-retrofit Energy Use (watts)	Pre-retrofit Energy Use (KW)	Post-retrofit Energy Use (watts)	Post-retrofit Energy Use (KW)	Percent Wattage Reduction Pre to Post retrofit	Energy Use Savings (watts)	Energy Use Savings (kW)	Lighting / Building Use (hrs/day)	Lighting / Building Use (days/yr)
Brevig Mission	33,643	33.64	14,506	14.51	57%	19,137	19.14	**7**	250
Chignik Lake	30,302	30.30	16,405	16.41	46%	13,897	13.90	**7**	250
False Pass	36,964	36.96	20,067	20.07	46%	16,897	16.90	**7**	250
Nikolski	4,902	4.90	2,321	2.32	53%	2,581	2.58	**7**	250
Pedro Bay	19,756	19.76	9,335	9.34	53%	10,421	10.42	**7**	250
White Mountain	27,364	27.36	14,276	14.28	48%	13,088	13.09	**7**	250
TOTALS	152,931	152.93	76,910	76.91	50%	76,021	76.02		

AEA LIGHTING RETROFIT PROJECT - Summary of Savings For '07 - '08 Grant Activities

With Building Use Estimates of 7 hrs / day, 250 days/year:

VILLAGES	Annual Savings (kWh)	Electricity Cost per kWh (without PCE) Fall 2008	Annual Village-wide savings (dollars)	Utility Fuel Usage (kWh/gal) from '07 AEA PCE Report	Annual Avoided Fuel Oil (gallons)	Diesel Cost per gallon (from '07 AEA, PCE Report)	Annual Avoided Fuel Costs (dollars)	Total Project Costs: All grant delivery, labor, materials, shipping and, disposal costs	Simple Payback (yrs)	# of Rural Entities Worked With	# of Buildings Worked In	# of Teacher Housing Units Worked In	Est. # of Maint. Staff Worked With
Brevig Mission	33,490	$ 0.53	$17,830	13.25	2,528	$1.88	$4,751.75	$37,775	2.12	4	11	7	6
Chignik Lake	24,320	$ 0.58	$14,144	8.99	2,705	$3.51	$9,495	$37,775	2.67	3	8	5	5
False Pass	29,570	$ 0.65	$19,309	11.62	2,545	$2.48	$6,311	$37,775	1.96	4	11	0	3
Nikolski	4,517	$ 0.65	$2,936	8.97	504	$3.33	$1,677	$37,775	12.87	3	2	1	4
Pedro Bay	18,237	$ 0.91	$16,595	13.79	1,322	$4.05	$5,356	$37,775	2.28	3	5	3	6
White Mountain	22,904	$ 1.08	$24,736	11.88	1,928	$3.05	$5,880	$37,775	1.53	3	11	0	6
TOTALS	133,037		**$95,551**		11,531	$18.30	$33,471	$226,650		20	48	16	30
	AVE:	$ 0.73											

	$95,551	Projected Annual Savings (dollars) for 6, '07-'08 - Villages
	$226,650	Total Grant Funds For All 6, '07-'08 Villages
Simple Payback:	**2.37**	years to payback entire grant @ 7 hrs/day & 250 hrs/yr

AEA LIGHTING RETROFIT PROJECT - Summary of Savings For '07 - '08 Grant Activities

With Building Use Estimates of 7 hrs / day, 250 days/year:

VILLAGES	# of 4' Fluorescent light Fixtures Retrofitted	# of CFLS Installed	# of Gym / Multi-purpose Bldgs Upgraded with T5s	Total Project Cost less CFL, T5 & Additional Measures Costs	Cost / Fixture in materials, shipping, village labor, ABSN Admin (Total project cost less T5, cfl and additional measures costs).	T5 (Materials and shipping Cost)	Additional Measures Beyond Lighting (Materials and Labor Cost)	Low-Mass Boiler training and instalation for SD Staff	Provided energy efficiency boiler training for # village maint staff	# Programmable T-Stats installed	Total In Kind Contribu-tions from all Village Entities
Brevig Mission	180	131	0				$9,000		1	10	$14,359.47
Chignik Lake	240	85	0				$6,000			2	$ 4,768.00
False Pass	275	71	1			$1,698	$900			2	$10,369.00
Nikolski	27	29	0				$11,500				$12,564.00
Pedro Bay	81	142	1			$2,954	$ 6,000			1	$6,764.92
White Mountain	235	17	1			$900	$ 1,000		1	3	$2,550.00
TOTALS	1038	475	3	$182,901	$ 176	$5,552	$34,400	0	2	18	$51,375.39

Lighting Strategy and Savings Estimates

During initial site visits we completed lighting assessments including quantity, locations, and wattage of existing fixtures. From initial assessments and site visits we designed lighting plans and applied various lamp and ballast combinations along with de-lamping strategies to achieve a balance of optimal energy efficiency and ample light levels for the activity at hand. From initial assessments and our lighting retrofit plans we determined pre and post energy use by building, village entity, village-wide and region-wide. With a known energy use, we could estimate energy and cost savings based on a predicted building and lighting use pattern. Since this information is extremely variable and would require separate grant funds to determine individual building use for these projects, we are reporting our saving estimates based on 250 days / year use and a 3-tier range of 4, 7, and 10 hours/day. For the purposes of these final reports we will focus on a mean lighting use of 7 hours/day. This generic use time is intended to average the use pattern of all buildings in our projects. Individual buildings and individual room spaces will have a wide range of use patterns. The actual savings and payback resulting from these projects we assume will fall somewhere within our range of 4 to 10 hours a day. To ground truth our 7 hour/day average run time we sampled run time data on lighting with building owners and occupants. These estimates varied largely even for the same building, but local run time estimates generally came in close (on one side or the other) to our 7 hour/day average. For the purposes of these reports we used full electricity rates including fuel surcharges and excluding PCE deductions. Rates are current small commercial (1-700 kWh), acquired from rural utilities in late fall of 2008.

The Oil Price Spike of 2008

With most village power generated through burning diesel fuel, the global price of oil has a profound effect on rural Alaska electricity costs. The VEUEEM grant projects covered in these final reports occurred during the highest global oil price spike in history. As a result, many villages had to endure the highest fuel and electric costs in their history. In the summer of 2008 the global price of oil spiked at over $150/barrel during the time window when most village entities had to order their bulk fuel for the winter of ’08-‘09. This resulted in crippling local village fuel costs. With most village power generated through burning diesel fuel, the oil price spike caused a corresponding spike in rural electricity costs through huge increases in fuel surcharges. These extreme costs of fuel and electricity in most of rural Alaska lasted through the winter of ’08 –’09, well past when the price of gas and oil related commodities dropped in the rest of road-connected America.

With the price of oil gradually returning to more normal levels in late 2008, and maintaining lower most likely through the spring and into the summer of 2009, rural utilities will be able to purchase their bulk fuel at markedly decreased prices compared with 2008. With this, rural costs of electricity for many villages will drop off and stabilize at lower levels. For these final reports, ABSN used electricity rates from late 2008, at the end of ’07-’08 projects which corresponded with peak electrical costs. However, average fuel prices for this time frame were not available from the AEA PCE program that tracks these rates. ABSN therefore used the latest average fuel price data available in March ’09, which was from the FY07 PCE Report (fuel pricing from summer 2006). Comparative avoided diesel costs shown in these reports reflect those rates, which are likely closer to current trends. In this discussion, it

should be noted that long-term savings and payback patterns from VEUEEM lighting and other energy efficiency measures will correspond directly with fluctuations in the price of oil.

Also of note on this topic, the price of village electricity and fuel are not the only elements effected by the global price of oil. The price of many materials and supplies associated with these projects rose considerably with the price of oil. Nearly all grant expenses in purchasing, shipping and travel increased in cost – thereby raising the cost of lighting measures and decreasing the number of measures beyond lighting that could be accomplished within grant budgets when compared to Phase I work completed in 2006.

Savings Estimates (Cont'd)

When considering savings estimates, it should be noted that for all practical purposes the only thing we can determine with reasonable accuracy is pre and post energy use. When it comes to savings, there are other questions that arise including: The volatile, global price of oil, and who actually sees the savings? If the energy use is reduced in a village, the required operating costs of a village utility must still be met. Utility rates will continue to increase to meet operating costs. Where savings occur, some will be to the State of Alaska in reduced PCE payments, and some will be to the electricity rate-payer. There is also the question of load verses capacity of a given generation system. In some cases where a generation system's capacity is over-extended, dropping the electrical load will be favorable for that utility as they may be spared the costs of generator replacement or overhaul. In other cases, if a system is somewhat oversized for the load already, an additional drop in electrical use may not be favorable to the utility or school. The optimal operating cycle of a given generator will consume a set amount of fuel over time. Reduction in electrical load may not translate directly to how much fuel is burned in a given generator.

Although these factors should be understood, the pressures of ever-increasing fuel costs, coupled with the facts of life in rural Alaska, necessitate the pursuit of energy efficiency programs wherever possible. Also, the trend of improved diesel generation technology, and the ability to tailor power generation levels to match load cycles, means that projects dedicated to overall load reduction are critical. This trend is another practical reason to pursue energy efficiency as an important principle.

We at ABSN are very pleased with the results of our work in association with these projects and are happy to be contributing toward energy efficiency cost savings for rural Alaska.

Savings and Payback Projections '07-'08 Villages

Community	Annual Electrical Savings Projections	Total Project Costs	Simple Payback (yrs)
Brevig Mission	$ 17,830	$37,775	2.12
Chignik Lake	$ 14,144	$37,775	2.67
False Pass	$ 19,309	$37,775	1.96
Nikolski	$ 2,936	$37,775	12.87
Pedro Bay	$ 16,595	$37,775	2.28
White Mountain	$ 24,736	$37,775	1.53
TOTALS:	$95,551	$226,650	2.37

Based on hours of operation: 7 hrs/day for 250 days/year

Savings and Payback Projections '07-'08 Villages

Community	Annual Electrical Savings Projections	Total Project Costs	Simple Payback (yrs)
Brevig Mission	$ 10,189	$37,775	3.71
Chignik Lake	$ 8,082	$37,775	4.67
False Pass	$ 11,034	$37,775	3.42
Nikolski	$ 1,678	$37,775	22.52
Pedro Bay	$ 9,483	$37,775	3.98
White Mountain	$ 14,135	$37,775	2.67
TOTALS:	$54,601	$226,650	4.15

Based on hours of operation: 4 hrs/day for 250 days/year

Savings and Payback Projections '07-'08 Villages

Community	Annual Electrical Savings Projections	Total Project Costs	Simple Payback (yrs)
Brevig Mission	$ 25,471	$37,775	1.48
Chignik Lake	$ 20,206	$37,775	1.87
False Pass	$ 27,584	$37,775	1.37
Nikolski	$ 4,194	$37,775	9.01
Pedro Bay	$ 23,708	$37,775	1.59
White Mountain	$ 35,338	$37,775	1.07
TOTALS:	$136,501	$226,650	1.66

Based on hours of operation: 10 hrs/day for 250 days/year

Notes on Budget and Grant Spending

Our objective is to spend grant funds evenly between villages to the greatest extent possible. To simplify accounting and purchasing large lighting orders are evenly split among villages and among VEUEEM grants. In financial reporting, grant expenditures are noted by village, and by the following budget categories: Field Management, Project Management, Travel Expenses, Materials, and Village Labor. Each village budget totals $37,775, which is the original total grant amount of $226,650 divided by six villages. As we get into spending for measures beyond lighting we select projects based on cost-benefit of the least project expense verses the most favorable savings and payback. Additionally projects are selected for measures beyond lighting according to local participation and initiative on the part of village entities to accomplish and enable projects through matching funds for labor or materials. To the degree necessary, village budgets for measures beyond lighting within the region were pooled to cover these measures.

Disposing and Recycling Old Lamps and Ballasts

ABSN's goal is to ensure that all old and unused lamps and ballasts are shipped out of the villages to Anchorage for proper disposal and recycling. In cases where the existing 34-watt T-12 lamps were fairly new, village building owners sometimes prefer to keep the materials and pass them along for continued use. In most cases, lamps are at or near the end of their useful lifespan and are no longer putting out optimum light. All fluorescent lamps contain mercury and as such should not be disposed of in landfills. . As part of '05 – '06 projects, ABSN developed a system of packing and shipping used lamps and old magnetic ballasts from the villages to Total Reclaim Inc. of Anchorage - the largest recycler of fluorescent lamps in the state. From Anchorage the lamps and ballasts travel by container ship to lower 48 recycling facilities. The mercury from lamps is reclaimed, and the ballasts are recycled for their materials.

For shipping used lamps and ballasts from most villages to regional hubs we arranged free back-haul service - generously provided by Alaska Transportation Service (ATS). From the hub communities back to Anchorage, Northern Air Cargo provides backhaul at slightly reduced rates for this program. Used lamps and non-PCB ballasts travel as general freight in properly sealed containers. Used lamps are categorized as non-hazardous universal waste.

Packing used lamps for recycling

A village shipment of used lamps and ballasts

Bring used lamps to the air strip


8ft, T-12 lamps prepared for recycling.


8ft lamp recycling container .

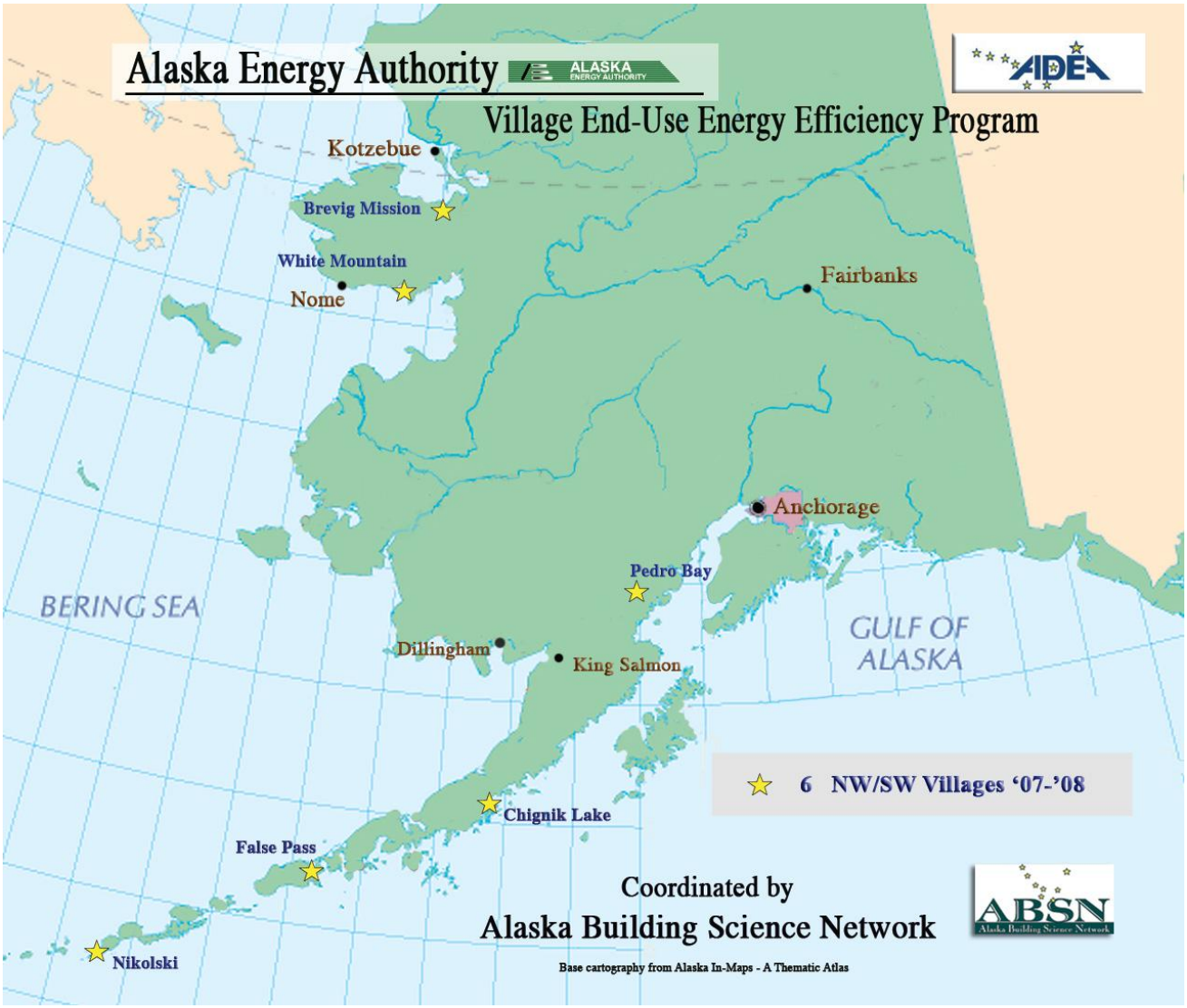

8ft lamps prepared for shipping.

PCB Ballast Disposal

Ballasts manufactured during or before 1979 are considered to contain PCBs, and are classified hazardous waste. In some villages where PCB ballasts are found, they must be dealt with under OSHA, EPA, and DOT regulations for proper removal and transportation. In the Nothwest - Southwest region, Brevig Mission and White Mountain had some PCB ballasts to remove and dispose of in order to complete lighting retrofits in all community buildings. As part of '05 – '06 projects, ABSN developed a PCB ballast removal and disposal method for village maintenance staff within EPA and DOT compliance and approved by the Alaska State OSHA office. Proper removal procedures were facilitated by ABSN, with the village building owner and their maintenance staff taking responsibility for proper removal - as the generator of the hazardous waste.


Double checking ballasts for PCBs

DOT approved haz-mat container of PCB ballasts ready for shipment



The following 6 village reports detail lighting and additional measures undertaken in each of our Northwest / Southwest region villages:

ELECTRONIC APPENDICES

Village End Use Energy Efficiency Measures Program ’07 – ‘08
West Region Final Reports

Electronic appendixes associated with these projects are provided as part of our final reports including:

- Cover page and Final Report Executive Summary, file name:
  (**Cover_ExecSummary_NW.SW_FinalReport07-08.doc**)

- Regional final reporting summary data, charts and calculations spreadsheets:
  (**SummaryFinalReportData_NW.SW_'07-'08.xls**)

- Final reports for each village in a folder titled:
  (**Final_ReportsVEUEEM’07-‘08_NW.SW**)

- Pre-Post retrofit spreadsheets for each village, in a folder titled:
  (**TallySheets_NW.SW_'07-'08_Final_Reports**)

- Contact information for all village contacts, file name:
  (**Contacts_NW.SW_VEUEEM'07-'08.xls**)

- **VEUEEM ’07 –’08 ACCESS Database**