

Project Completion Report Rocky Mountains Cooperative Ecosystem Studies Unit (RM-CESU)

Project Title: Implement Light Study Recommendations and Conduct Preventative Museum Preservation Tasks at Grant-Kohrs Ranch NHS

Project Code: CSURM-189 J1586100010

Type of Project (Research, Technical Assistance or Education): Technical Assistance

Funding Agency: National Park Service

Partner University: Colorado State University

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Project Summary, including descriptions of project deliverables, work accomplished and/or major results. If the information is restricted (e.g. location of endangered species or cultural resources), indicate the title and location of the final report. Also add web sites where project-related information may be found.

Attached is a final report by the CSU hire, Sarah Tisdale.

Number of students participating in this project: undergraduates, graduate students, degrees conferred.

1 degree conferred

Project: Implementation of 2010 Light Study Recommendations

Sarah Tisdale

August 30, 2010

Light Exposure Guide

In order to create a light exposure guide, I first looked at yearly light monitoring data for the years 2007 to 2010 in order to gain an understanding of recent light levels in each room of the ranch house. Next, I created my own list of objects and light sources in each room and took measurements throughout the day on both a sunny and a cloudy day. These readings were then used to calculate the average light level of each room.

Utilizing the yearly exposure recommendations of both the Illuminating Engineering Society North America (IESNA) and the Chartered Institution of Building Services Engineers (CIBSE) and taking into account the different types of objects and their sensitivity level, I wrote a light exposure guide detailing recommended light levels for each room. An estimate of how many hours the lights are on and the shades are up each year was used to recommend light levels that would keep the overall yearly exposure well within professional standards. Furthermore, the guide briefly describes the types of objects and their light sensitivity levels in various rooms and includes a monitoring procedure.

See Appendix A for light exposure guide.

Table of Illumination and Solar Altitude Chart

Although these are recommended by Garry Thomson in *The Museum Environment*, they proved to be rather difficult to attain. I contacted several universities, including Montana Tech, University of Montana, and Montana State University as well as NOAA. All of these contacts had never seen an illumination chart like Thomson recommends. However, Ben Schott at NOAA directed me to the National Renewable Energy Laboratory's Renewable Resource Data Center website, which has a listing of the 30-year averages of solar radiation and illuminance from 1961-1990 for locations across the country. The closest location to Deer Lodge is Helena. See Appendix B for examples of illumination charts generated on-line.

A solar altitude chart would be extremely difficult to pull together. However, the United States Naval Observatory (USNO) has a website which allows one to bring up a chart of the solar altitude for one day in ten minute increments. This will be useful when making decisions in which shades in the Dining Room should be opened and at what time. The website is <http://www.usno.navy.mil/USNO/astronomical-applications/data-services/alt-az-us>.

Lamps, Glass Shades, and Carbon Filament Light Bulbs

Two reproduction kerosene lamp fonts and three electrified burners with made-to-order sixteen foot cords were purchased from Antique Lamp Supply. The intention is that one of these lamps will be placed in the office. The second lamp is for wherever extra light is desired. For example, when a desk is purchased for the Bielenberg Room, then the lamp could be used there. An extra cord was purchased in case more electrified kerosene lamps are needed in the future.

A replacement glass shade for the Master Bedroom light fixture near the bed was also ordered from Antique Lamp Supply. In regards to replacing the shade in the Parlor, several antique shade dealers agreed that they had not seen any like it. Museum Quality Reproductions was contacted, but after initial discussions failed to respond. To that end, two similarly shaped shades were ordered from House of Hardware with the intention of placing both in the Music Room while taking one of the Music Room's original shades and putting it in the Parlor. Reproduction shades have been marked with "NPS 2010."

At the beginning of the summer, several experiments with carbon filament light bulbs were made. Initially, all bulbs on the first floor were switched to the carbon bulbs. It was very apparent, however, that these bulbs are too dark for certain areas of the house. For example, the bulbs are too dim in the Music Room and Parlor for visitors who have just stepped in from outside.

To that end, there are now carbon filament light bulbs in the Bielenberg Room, half of the gasoliers of the Sitting and Dining Rooms, the Bathroom, the Master Bedroom, the Back Hallway, the Kitchen, and in the center fixture of the Parlor. 40 watt incandescent light bulbs are in the Music Room, the Parlor, half of the chandeliers of the Sitting and Dining Rooms, the Northwest Bedroom, and the Office.

Extra carbon filament light bulbs are stored in a cupboard in the kitchen on the second floor. Because there are enough extra bulbs, no additional bulbs were ordered. However, they can be purchased at the House of Hardware website (<http://houseofantiquehardware.com/>) or at Rejuvenation (<http://www.rejuvenation.com/> .)

Wiring

In order to plug in the electrified kerosene lamps, some rewiring is necessary. Compliance paperwork was submitted to SHPO for review, and they agreed with the "No Adverse Effect" finding. The rewiring project includes adding a new outlet in the Office closet and in the shed next to the Northwest Bedroom. In both cases, already existing wiring will be used and in areas that have previously had the historic fabric altered.

One recommendation in the lighting study is to have interpreters turn off the lights at the end of each tour. This would save as many as two hours a day, and possibly more for the times there are no tours. At this point in time, the closest switches interpreting staff has are those under the front staircase. There are now plans to rewire switches at the top of the staircase down to the basement in the kitchen. These switches would be much closer to the back door, where tours come to an end. Once this switch is in place, interpreting staff can be asked to turn off the lights as they finish each tour. SHPO has also approved this wiring project.

Silk Plants

The use of silk plants in conjunction with window film and screens placed on the windows of the Dining Room was recommended as a means of opening the shades at certain times of day. Although the screens are still being produced and window film is on order, enough larger silk plants have been purchased to create a “jungle” in the Dining Room.

Two rubber trees, two asparagus ferns, one parlor palm, one maiden hair fern, and several boston ferns are now in place. Different types of silk flowers have also been purchased to be change out at different times of the year.

Curtains, Valances, and Roller Shades

“Modesty” curtains were made from white muslin, as suggested in the *Historical House Furnishing Study* and hung in the Northwest Bedroom, Bathroom, and Kitchen using spring rods with felt on the ends to protect the wood. The lace curtains were removed from the Bathroom, as it is unlikely that Augusta would have had a roller shade, lace curtains, and the modesty curtain all at the same time. However, the lace curtains remain in the Northwest Bedroom in order to block glare and to protect delicate objects, such as Willie’s horse drawing, in the room.

Reproduction lace curtains were ordered from Decorating with Lace, a website dedicated to Victorian era lace for the transom and sidelights of the front door. Curtain rod hardware was installed on the window inserts and not the historic wood.

Historic valances were prepared for hanging in the Sitting Room. Drapery tape with bias tape loops were stitched along the top of the back of each valance in order to take tension off of the original fabric and wooden rings. The valances were hung from the wooden rods where lace curtains previously had been. The lace curtains were shortened and hung below the valances using purchased curtain rods. Existing hardware was used for rods with addition of one new hook on the northeast window.

The reproduction roller shades on the first floor were not altered. Melinda Lincoln at Sierra Window Coverings did not recommend adding material to the top of the rollers as this would make it difficult to roll the shades. Material matching the current shades could not be found, making it difficult to add material to the bottom of the shades. However, after discussing the matter with Chief Interpreter Julie Croglia and Museum Aid Katie Mathew, it is evident that the shades that are the most difficult to use are rarely opened, and more often than not only when yearly cleaning is done.

Desk for Bielenberg Room

After much searching on-line, contacting various antique dealers, and corresponding with Harpers Ferry Center Staff Curator Andy Chamberlain, it is apparent that the oak desk originally

in the Bielenberg Room is extremely difficult to find. Purchasing an antique desk close to the style would be at least \$3,000, plus shipping and handling.

One possible solution is having a mock desk custom built by Hochstetler Custom Kitchens in Gold Creek. Mr. Hochstetler offered a quote of \$1,280 plus the cost of leather for the writing pad. See Appendix C for official quote and sketch provided by Mr. Hochstetler.

Once the desk is procured, a chair will also need to be found.

Light Filtering Window Film

Well-known window film providers, including 3M, were contacted in regards to putting film on the window inserts of the house. All agreed that it would be impossible to put adhesive tint on the Plexiglas inserts as the cleaning process would damage the Plexi. The majority also did not feel comfortable installing the film on historic glass, as well as on divided windows.

Historic architects also did not advise placing film directly onto the windows. Vicky Jacobson, historic architect for the region, suggested Energy Film, a non-adhesive transparent film.

A large piece was ordered and experiments done on one of the windows in the Dining Room. The first attempt was unsuccessful, but it appears the film peeled off because of improper size and of a clear plastic sheet that was not removed. A second attempt proved more successful. In this case, the plastic cover was removed, and more space was left around the edges so that the water used to apply the film could dry out.

SHPO agreement with a “no adverse effect” declaration has been received, and the film is on order. When installation commences, cutting the film at least half an inch smaller than the glass is recommended, as well as removing the plastic sheet on the portion facing the room. See Appendix D for the Plexiglas window measurements.

Conclusion

In summation, there are several recommendations that will need to be wrapped up. These include:

- Having the outlets and the switches at the top of the stairs in the kitchen rewired
- Plugging in the kerosene lamp in the office for additional light
- Installing the window film
- Completing the screens for the brick portion of the house
- Altering the shade/light schedule for the house once film, screens, switches, and outlets are in place and informing interpreters of these changes

For the final budget of this project, see Appendix E.

Appendix A: Light Exposure Guide for HS1

Light Exposure Guide for HS-1

Light level recommendations are based on approximate calculations of the number of hours the ranch house is open each year. Using ranch house tour data, it is estimated that the house is open approximately 153 days for eight hours in the summer and about 273 hours in the winter. Therefore, the given exposure estimates are based on the assumption that the lights are on and the shades are up for about 1,500 hours per year, with some leeway for additional hours factored in.¹

The suggested light levels take into account not only professional light level guidelines, but also the length of exposure. This light exposure guide uses the yearly exposure recommendations put together by the Illuminating Engineering Society of North America (IESNA) and the Chartered Institution of Building Services Engineers (CIBSE.) IESNA's recommendations are as follows:

Objects highly susceptible to damage: 50,000 lux-hours per year

Objects moderately susceptible to damage: 480,000 lux-hours per year

CIBSE's guidelines are:

Highly susceptible to damage: 54,000 lux-hours per year

Moderately susceptible to damage: 500,000 lux-hours per year

See Appendix A for estimate of current light levels and annual exposure in the ranch house.

This is a room-by-room guide that includes general light levels for each room. It is important to note, however, that in several rooms there are objects that might need a lower light level than that of the room at large. This can be achieved by ensuring that certain objects are kept out of direct light, while other parts of the room receive slightly higher light levels.

Room 101: Master Bedroom

Recommended light level: 75 lux

Total yearly exposure: 112,500 lux hours

The Master Bedroom contains some fragile objects, such as the textiles on the bed, original carpeting, and pictures on the wall. These objects, however, are mainly kept in shadows. Objects that receive the most direct light are mainly wood pieces. To that end, this room is considered to be moderately susceptible.

Room 102: Office

¹ Please note that as changes are made to aspects of the lighting plan, such as having interpreters turn off the lights after each tour, these light levels can be raised slightly. Having the lights off at the end of each tour could save about two hours per day, meaning that the lights would be on for approximately 1,200 hours per year as opposed to 1,500.

Recommended light level: 150 lux
Total yearly exposure: 225,000 lux hours

The Office has objects that are overall moderately susceptible to damage. The furniture is wood and leather. There are books in the bookcase, a blanket on the couch, paintings on the wall, and original carpeting, but these items can be protected from direct light.

Room 103: Front Hallway

Recommended light level: 150 lux
Total yearly exposure: 225,000 lux hours

The most fragile object in the Front Hallway is the carpet on the stairs. Curtains on the transom and sidelights of the front door will help limit the carpet's exposure. The door to the music room and the hall stand will also be protected more.

Room 104: Music Room

Recommended light level: 40 lux
Total yearly exposure: 60,000 lux hours

The Music Room has ceramics, paintings, wood furniture, and a small amount of textiles as well as original carpeting. To that end, it is considered just below highly susceptible to damage. More susceptible objects like the pastel to the left of the parlor are exposed to an average light level of 14 lux, making its exposure about 21,000 lux hours per year, well below the recommended 50,000 lux hours per year for fragile objects.

Room 105: Parlor

Recommended light level: 25 lux
Total yearly exposure: 37,500 lux hours

The Parlor contains many textiles, making the room overall highly susceptible to damage. To that end, maintaining a lower light level is important.

Room 106: Bielenberg Room

Recommended light level: 150 lux
Total yearly exposure: 225,000 lux hours

The Bielenberg Room has two paintings, some textiles, some leather, and wood furniture. It is moderately susceptible to damage, as long as light exposure to the textiles is monitored and/or the textiles (such as the towel on the washstand) are rotated off exhibit.

Room 107: Sitting Room

Recommended light level: 50 lux
Total yearly exposure: 75,000 lux hours

The Sitting Room, like the Parlor, has a variety of objects. While the light level of the room as a whole can be kept at 50 lux, some objects need to be protected. In particular, the Grant suttee

should be kept out of direct light and kept at 20 lux. In its current location, its average light level is 12 lux, keeping it well below 50,000 lux hours per year.

Room 108: Bathroom

Recommended light level: 200 lux

Total yearly exposure: 300,000 lux hours

The Bathroom has the least amount of fragile objects. Objects in this room are basically metal, wood, ceramic, and marble. The one historic textile in the room can be rotated off exhibit. For these reasons, the light level in the bathroom can be kept higher.

Room 109: Northwest Bedroom

Recommended light level: 75 lux

Total yearly exposure: 112,500 lux hours

The Northwest Bedroom contains objects similar to those of the Master Bedroom – wood furniture, some textiles, and two pictures. The laundry bag on the bed, the pillow cases, and the pictures on the bed should be kept from direct light, hence keeping their exposure to a lower level.

Room 112: Back Hallway

Recommended light level: 300 lux

Total yearly exposure: 450,000 lux hours

The moderately susceptible objects in the Back Hallway, the table, umbrellas, and picture, are not in direct light. Their light levels are lower than the areas directly across from the window, where the light levels are higher. This allows for the total light level of this area to be higher.

Room 113: Dining Room

Recommended light level: 35 lux

Total yearly exposure: 52,500 lux hours

The Dining Room contains a variety of objects, including paintings, prints, dishware, wood furniture, and textiles. Therefore, the light level overall should be kept fairly low.

Room 114: Pantry

Recommended light level: 150 lux

Total yearly exposure: 225,000 lux hours

The Pantry does not contain many extremely fragile objects; it has dishware, wood cupboards and reproduction curtains. There is a basket on display, however, that should be kept more in the shadows and/or rotated off exhibit.

Room 115: Kitchen

Recommended light level: 150 lux

Total yearly exposure: 225,000 lux hours

The Kitchen is much like the Pantry in terms of the susceptibility of its objects, and therefore can be kept at a slightly higher light level.

Monitoring Procedure

In order to ensure that the total sum of exposure does not exceed the maximums listed here, annual monitoring is necessary. The average light level of each room can be found by taking measurements in specific places at different times of day and then averaging these readings. The resulting average should fall within the limits specified in this guide. It is also recommended that readings be taken on both a cloudy day and a sunny day. In order to find an estimate of total yearly exposure, multiply the average light level by 1,500 (the estimated time the lights are on and shades are up per year.)

See Appendix B for the checklist of places to take measurements in each room.

Light Exposure Guide Appendix A: Estimates for Current Light Levels and Annual Exposure, as of August, 2010

Estimates are averages based on yearly light monitoring records from 2007 to 2010 and measurements taken throughout the day on both a cloudy day and a sunny day. Various areas of each room were measured, then averaged to find the general light level of the room.

Room	Daily Light Level – lux	Yearly Total – lux-hours
101 Master Bedroom	68.8995	103,349
102 Office	98.4175	147,626
103 Front Hallway	41.4015	62,102
104 Music Room	42.271	63,407
105 Parlor	17.4015	26,102
106 Bielenberg Room	14.4045	21,607
107 Sitting Room	69.1525	103,729
108 Bathroom	24.366	36,549
109 Northwest Bedroom	45.684	68,526
112 Back Hallway	353.8265	530,740
113 Dining Room	33.6315	50,447
114 Pantry	31.3185	46,978
115 Kitchen	74.707	112,061

Light Exposure Guide Appendix B: Light Reading Checklist for Average Light Levels

Room/Location	10 am		1 pm		3 pm		Ave.
Room 101	fc	lux	fc	lux	fc	lux	lux
vanity by N window							
vanity under right light							
bed							
dresser by office door							
Room 102			shade up				
desk under light							
in front of SE shade							
lounge							
Room 103							
hall stand							
2 nd stair							
Room 104			shade up				
North door							
pastel							
EWall bookcase							
Room 105							
red rug							
chair near NE shade							
lambrequin							
middle table							
SE painting frame							
EWall couch							
Room 106							
wash stand:							
flask							
towel							
Ben Kingsbury painting							
dresser							
Room 107							
Grant suttee							
center chair near north windows:							
facing window							
facing table							
rug on table							
fainting couch							

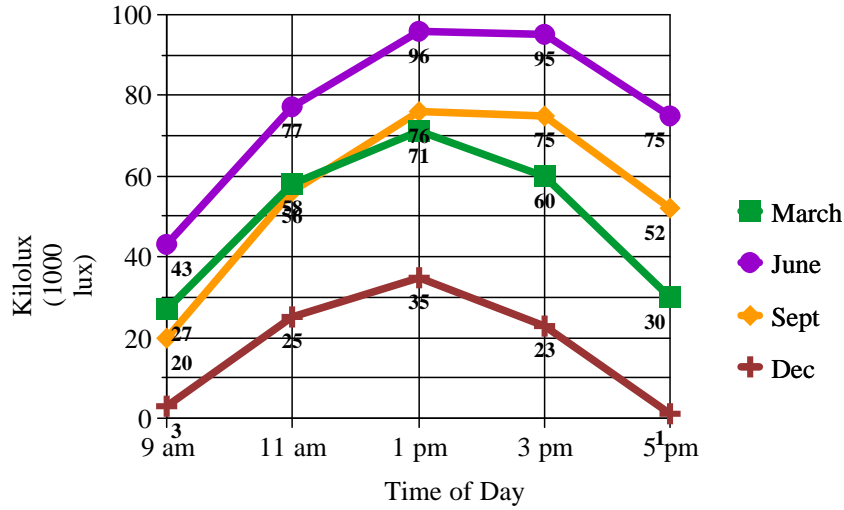
leather chair near North windows							
Room 108							
marble wash stand							
sink							
Room 109							
laundry bag							
horse drawing							
Room 112							
in front of window							
table							
Room 113							
rug with shades:							
down							
up							
screen with shades:							
crane, down							
peacock, down							
crane, up							
peacock, up							
table, shades:							
down							
up							
Room 114							
wicker basket							
NE cupboards							
Room 115							
wicker basket							
cupboard, SWall							
pie safe							

Note: 1 fc = 10.76 lux

Average column labeled "Ave." will only have one number for each room; average all of the light readings for the different times of day and the different locations for each room.

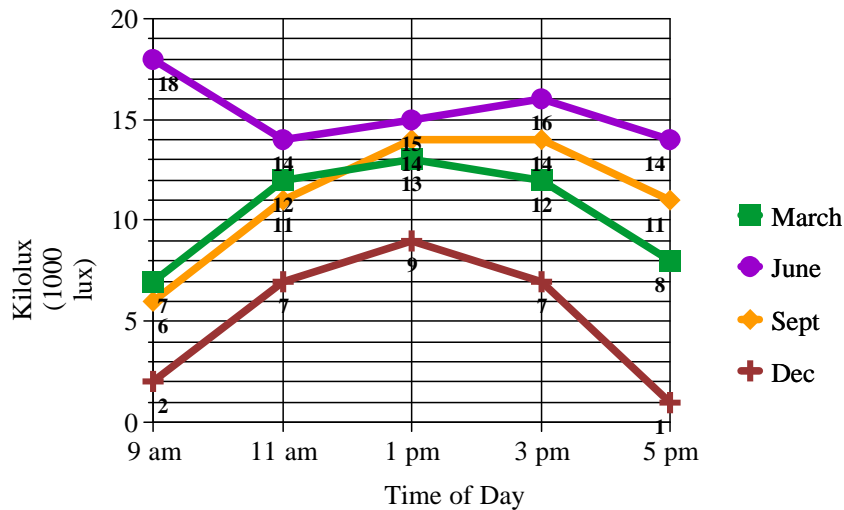
Appendix B: Data for the 30 Year Average of Illuminance in kilolux (1000 lux) for Helena, MT (1961-1990)

30 Year Average of Illuminance for Helena, MT: Horizon



National Renewable Energy Laboratory's Renewable Resource Data Center http://rredc.nrel.gov/solar/old_data/nsrdb/bluebook/data/24144.SBF

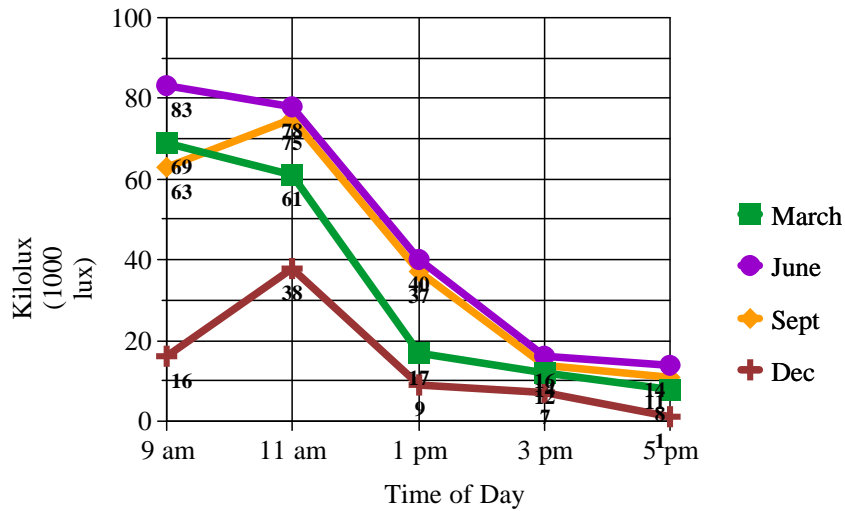
30 Year Average of Illuminance for Helena, MT: North



National Renewable Energy Laboratory's Renewable Resource Data Center http://rredc.nrel.gov/solar/old_data/nsrdb/bluebook/data/24144.SBF

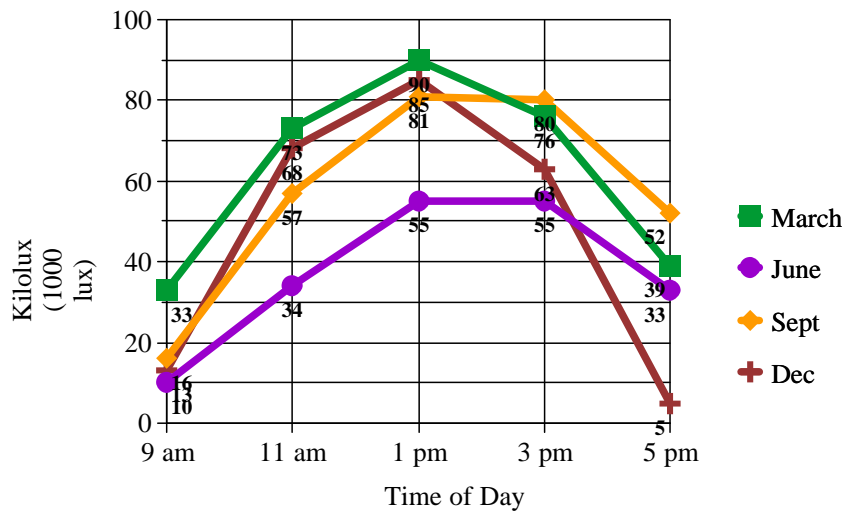
Appendix B: Continued

30 Year Average of Illuminance for Helena, MT: East



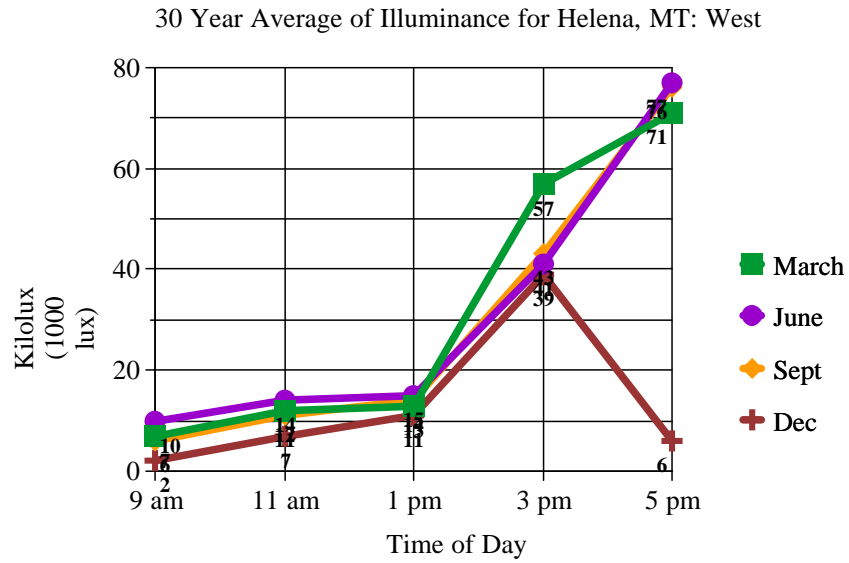
National Renewable Energy Laboratory's Renewable Resource Data Center http://rredc.nrel.gov/solar/old_data/nsrdb/bluebook/data/24144.SBF

30 Year Average of Illuminance for Helena, MT: South



National Renewable Energy Laboratory's Renewable Resource Data Center http://rredc.nrel.gov/solar/old_data/nsrdb/bluebook/data/24144.SBF

Appendix B: Continued



National Renewable Energy Laboratory's Renewable
Resource Data Center [http://rredc.nrel.gov/solar/old_data/
nsrdb/bluebook/data/24144.SBF](http://rredc.nrel.gov/solar/old_data/nsrdb/bluebook/data/24144.SBF)

Appendix C: Hochstetler Custom Kitchens Quote and Sketch for Desk

Quote No. 1086

Hochstetler Custom Kitchens 9 Hereford Lane Gold Creek, MT 59733 Ph:
406-560-6490 Fax: 406-288-2298

Quote

Customer		Misc	
Name	_____	Date	_____
Address	_____	Order No.	_____
City	_____ State _____ ZIP _____	Rep	_____
Phone	_____	FOB	_____

Qty	Description	Unit Price	TOTAL
1	desk for Grant-Kohrs plus leather	\$ 1,280.00	\$ 1,280.00
1	raised panels	\$ 364.00	\$ 364.00
1	fronts	\$ 90.00	\$ 90.00
1	top	\$ 196.00	\$ 196.00
1	labor	\$ 600.00	\$ 600.00
1	finish	\$ 30.00	\$ 30.00
SubTotal		\$	2,560.00
Shipping			
Tax Rate(s)			
TOTAL		\$	2,560.00

BRGAL-COV
OF ABOVE
PRICE

Payment

Comments _____

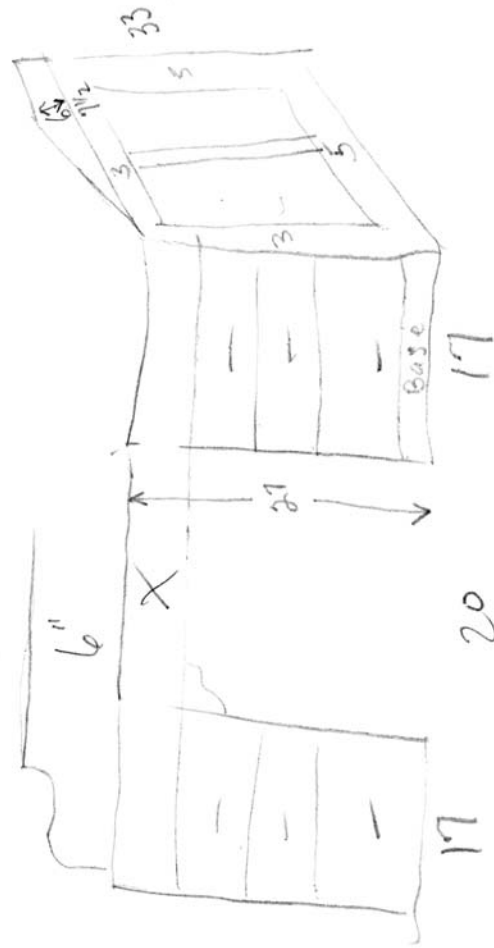
All returns must be made within 60 days and must be accompanied by original invoice. Returns subject to 15% restocking fee. A late charge of 2% per month applied on all past due accounts.

Thank-you for your business!

Appendix C: Continued

3 1/2
3 1/2
5 1/2
3

Full inset



3x3
7
18
8
26.59 ft

Raised panels	364
Fronts	90
top	196
Leather	R
Labor	600
Finish	30
	<hr/>
	\$1280+

← 54 →

Appendix D: Measurements for Plexiglas of Window Inserts

Note: These are the actual measurements of the Plexiglas; nothing has been subtracted from the numbers.

Room	Length	Width
Music Room	27	31 1/8
Parlor		
East Wall, North	27	30 7/8
East Wall, South	27	30 7/8
South Wall, West	27	31
South Wall, East	27 1/8	31
Bielenberg Room	27 3/4	37 5/8
Sitting Room		
South Wall	35 7/8	29 5/8
North Wall, East	36 3/8	31 1/8
North Wall, West	36 1/4	31 1/8
Bathroom	28	31 5/8
Northwest Bedroom	27 3/4	31 5/8
Master Bedroom		
North Wall	27	31
East Wall	27 1/8	31
Office		
East Wall, North	27 1/8	30 3/4
East Wall, South	27 1/8	31
Dining Room		
Center Window, East	36 1/2	30
Center Window, West	36 1/2	30 1/2
West Side Window	36 1/2	30 3/8
East Side Window	36 1/2	30 3/8
Back Hallway	36 1/8	31 1/4
Kitchen		
North Wall	36 1/4	31 1/8
West Wall	37	31 1/8
Pantry	36 7/8	31 5/8

Appendix E: Final Budget for Lighting Recommendations Project

Purchased Items	Cost	Total
Silk palm plant, boston fern, clay pots for these	\$86	\$86
Spring curtain rods, 3 @ 7.99	23.97	109.97
Curtain rods for lace curtains in sitting room	17.47	127.44
Lace curtains made to fit for front hall	171	298.44
Fabric for modesty curtains, 5 yards @4.99 w/40% of coupon (w/out tax)	14.97	313.41
2 4' rubber plant, 1 18" maidenhair fern, 2 50" asparagus ferns	287.39	600.80
4 pots, 2 saucers, foam for purchased plants	44.89	645.69
Materials for hanging valances	16.01	661.70
Curtain rods for lace curtains on front door, 4 @ 4.29	17.16	678.86
2 lamps, 2 chimneys, 6 flame shaped bulbs, 3 16' cord electrified burners, 1 reproduction glass shade, plus shipping and handling and extra 11.25 for special length cords	206.94	885.80
2 reproduction glass shades for Music Room	151.58	1037.39
36" x 48" Energy Film panel	27.99	1065.37
Energy Film 4' x 100' roll, shipping and handling included	683.86	1749.23
Future Purchases		
Desk through Hochstetler Custom Kitchen	1500	3249.23
Research Project	2400	5649.23