

96-9430

96-9430

Ident. No. 75587

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES
APPLICATION FOR PERMIT

To appropriate the public waters of the State of Idaho

1. Name of Applicant RALPH Lloyd AND/OR ALICE M. WALLACE Phone 208-263-0895
Mailing address 299 DELTA View Rd, Hope, Id 83836 Email WALLACE @ SANDPOINT. ID
2. Source of water supply KIRBY CREEK which is a tributary of PACK RIVER
3. Location of point of diversion is Township 57N Range 1E Sec. 8 in the NE $\frac{1}{4}$,
NE $\frac{1}{4}$, NW $\frac{1}{4}$, Govt. Lot _____, B.M., BONNER County;
additional points of diversion if any: _____
4. Water will be used for the following purposes:
Amount 1.5 CFS for HYDRO-POWER purposes from Nov 1 to June 30 (both dates inclusive)
(cfs or acre-feet per year)
Amount .75 CFS for HYDRO-POWER purposes from JULY 1 to OCT 31 (both dates inclusive)
(cfs or acre-feet per year)
Amount 1.0 for FIRE PROTECTION purposes from JAN 1 to Dec 31 (both dates inclusive)
(cfs or acre-feet per year)
Amount _____ for _____ purposes from _____ to _____ (both dates inclusive)
(cfs or acre-feet per year)
Amount _____ for _____ purposes from _____ to _____ (both dates inclusive)
(cfs or acre-feet per year)
Amount _____ for _____ purposes from _____ to _____ (both dates inclusive)
(cfs or acre-feet per year)
5. Total quantity to be appropriated is (a) 1.8 and/or (b) _____
cubic feet per second acre feet per year
6. Proposed diverting works:
 - a. Describe type and size of devices used to divert water from the source SEE "EXPANDED INFORMATION" Pages 6-8 • STEEL CONSTRUCTION OF 110 sq. ft. • W/ GRAVITY FEED.
 - b. Height of storage dam _____ feet; active reservoir capacity _____ acre-feet;
total reservoir capacity _____ acre-feet
 - c. Proposed well diameter is _____ inches; proposed depth of well is _____ feet
 - d. Is ground water with a temperature of greater than 85°F being sought? NO
 - e. If well is already drilled, when? _____; Drilling firm _____;
Well was drilled for (well owner) _____; Drilling Permit No. _____
7. Time required for completion of works and application of water to proposed beneficial use is 4 years (minimum 1 year)
8. Description of proposed uses (if irrigation only, go to item 9):
 - a. Hydropower; show total feet of head and proposed capacity in kW. 200' Head 9.99 KW
 - b. Stockwatering; list number and kind of livestock. _____
 - c. Municipal; show name of municipality. _____
 - d. Domestic; show number of households. _____
 - e. Other; describe fully. THIS APPLICATION IS TO FINISH PREVIOUSLY PERMITTED PROJECT. PERMIT # 96-08951 JAN. 21, 1997
"SHOVEL READY" - MOST OF PROJECT IS COMPLETED SEE EXPANDED INFO

9. Description of place of use:

- a. If water is for irrigation, indicate acreage in each subdivision in the tabulation below.
- b. If water is used for other purposes, place a symbol of the use (example: D for Domestic) in the corresponding place of use below. See instructions for standard symbols.

TWP	RGE	SEC	NE				NW				SW				SE				TOTALS
			NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	NE	NW	SW	SE	
59N	1E	8					P												
"	"	8					F												

Total number of acres to be irrigated: _____

10. Describe any other water rights used for the same purposes as described above. Include water delivered by a municipality, canal company, or irrigation district. If this application is for domestic purposes, do you intend to use this water, water from another source, or both, to irrigate your lawn, garden, and/or landscaping? _____

11. a. Who owns the property at the point of diversion? APPLICANT - See TAX MAP & Deed Pg. A3, A4
- b. Who owns the land to be irrigated or place of use? APPLICANT - " " " " " " "
- c. If the property is owned by a person other than the applicant, describe the arrangement enabling the applicant to make this filing: _____

12. Describe your proposal in narrative form, and provide additional explanation for any of the items above. Attach additional pages if necessary. SMALL HYDRO-POWER SYSTEM CONSISTING OF 4 FACILITIES/STRUCTURES
- ① HEAD WORKS DIVERSION STRUCTURE - See EXPANDED INFORMATION Pgs. 6-8
- ② BURIED PIPELINE OR "PENSTOCK" - " " " " Pgs. 8, 9
- ③ POWER HOUSE AS PICTURED - " " " " Pgs. 2, 14
- ④ TAIL-WORKS AS FINISHED - See PICS - " " " " Pg. 6, 8, 10
- ENVIRONMENTAL PROTECTIONS - AIR - WATER - SOIL - NOISE Pgs 6-10
- PUBLIC BENEFITS - ENVIRONMENTAL & ECONOMICAL. Pgs 11-13
- DOCUMENTS - CITIZENSHIP - RESIDENCY - CERTIFIED TAX MAP - DEED A1-A4

13. **MAP OF PROPOSED PROJECT REQUIRED** - Attach an 8½"x11" map clearly identifying the proposed point of diversion, place of use, section #, township & range. (A photocopy of a USGS 7.5 minute topographic quadrangle map is preferred.)

BE IT KNOWN that the undersigned hereby makes this application for permit to appropriate the public waters of the State of Idaho as herein set forth.

Ralph Lloyd Wallace
Signature of Applicant

RALPH LLOYD WALLACE
Print Name (and title, if applicable)

For Department Use:

Received by _____ Date 5-7-09 Time 10:00 Preliminary check by _____

Fee \$ 290.00 Received by EL Receipt No. N020507 Date 5-7-09

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

AFFIDAVIT FOR WATER RIGHTS TO BE USED FOR POWER PURPOSES

A. Establishment of Residency: (Complete either 1, or 2).

1. Individual Applicant or Individual Members of a Partnership:

I, R. Lloyd Walker (name) of HOPE ID (city),
County of Bonner, State of Idaho, being duly sworn, do hereby
certify that I am a bona fide resident of the State of Idaho.

2. Corporation:

I, _____ (name) of _____ (city),
County of _____, State of Idaho, being duly sworn, depose and
say: That I am the designated registered agent of the _____
_____ : that as such I am in charge of the registered office of the said
(name of corporation)
corporation as required by Section 30-1-12, **Idaho Code**, at _____ (city)
Idaho, wherein are kept the corporate records required by Section 30-1-52, **Idaho Code**: and that _____
_____ is a corporation qualified to do business in the State of Idaho under the laws
(name of corporation)
of the State of Idaho.

B. Ownership of Facilities: (To be completed for hydropower projects only)

The hydropower facility to be developed pursuant to the attached Application for Permit:

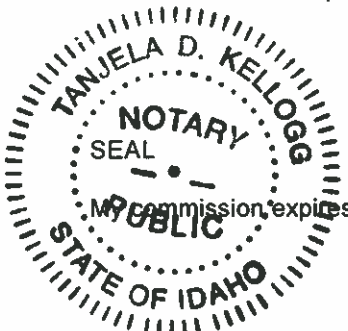
(check one)

- ☒ Will not utilize existing man-made irrigation facilities such as a dam or a canal.
☐ Will utilize existing man-made irrigation facilities such as a dam or a canal, and permission of the owner is documented in an affidavit attached hereto.
☐ Will utilize existing man-made irrigation facilities such as a dam or a canal, and the owner is the signee of this affidavit.

R. Lloyd Walker
Applicant

STATE OF IDAHO)
County of BONNER)ss

On this 30th day of APRIL, 20 09, personally appeared before me the signer(s) of
the above instrument, who duly acknowledged to me that he (she) (they) executed the same.



Tanjela D. Kellogg
Notary Public residing at
Sandpoint, ID Bonner County

WALLACE



0 55 110 220 330 440 Meters

Legend

- QQ
- Township/Range
- Sections



1402-134

611040

16

USDA-F

8-24-02

Restricted Access National Forrest

BLM Managed Lands

Head-works

Power House

Pack River Delta

FS160 1/ 400 f/4.0 FF--- EC--- SP- v/h.03221 62% dt017.4 ds011 25.4V -74mb

96-9430

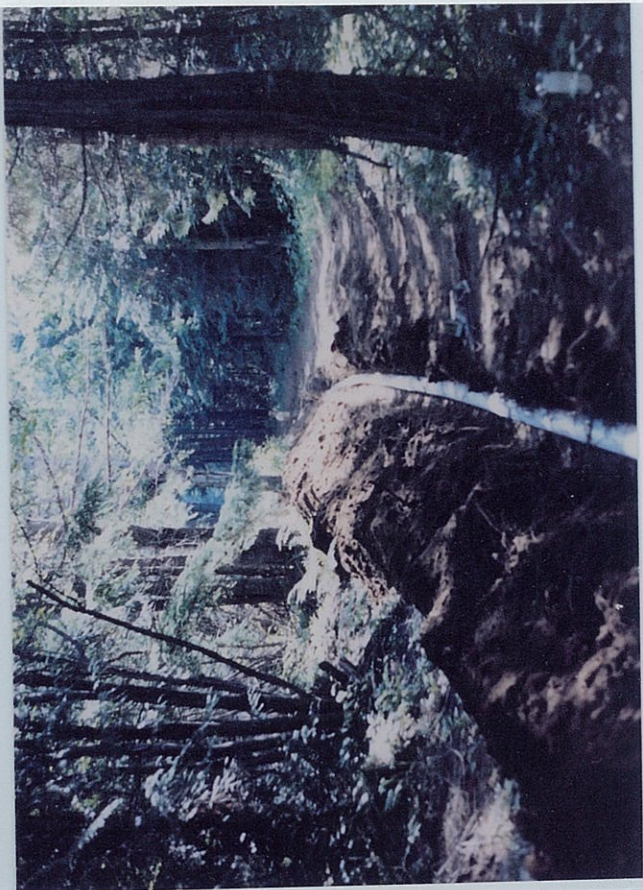
EXPANDED INFORMATION

FOR APPLICATION PERMIT TO APPROPRIATE THE PUBLIC WATERS OF THE STATE OF IDAHO

Applicant: R. Lloyd & Alice M. Wallace
299 Delta View Rd., Hope, Id. 83836
Phone # (208) 263-0895 e-mail = wallace@sandpoint.com

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Proof of citizenship & residency, to perform this project ----- Page A-1, 2
Proof of project land ownership - copies of Certified Tax Map & Deed- Pages A-3,4
Topographical Map showing watershed location & size. ----- Page A-5
Stream photo pages showing Impossibility of fish migration. ----- Pages A-6-8
Bonner Soil Survey Map & Soil description for project **pages in back** - 8 Pages
Copy of Appropriate Technology Small Grants Program # 2-80-056 ----- Available

INTRODUCTION

We hope the IDWR & IDFG will use this expanded information to better understand the application and to answer everyone's questions or concerns about this project.

This application is an application for **a new permit to finish a previously permitted project.** That project **permit (# 96-08951)** was granted in Jan. '97 and with extension, ran out Jan. 1, 2007. Some pictures of the progress of that project were taken and where useful will become a part of this application. A **question naturally arises** "why wasn't that project completed and put to beneficial use during the first permit or extension period?" **See "Answer" at end of Introduction,** if interested.

This project consists of four parts. **Top left picture is the actual head-works** (110' sq), an 8" penstock, a **small** power-house (8' x 12') as at left, and **the actual small tail works shown bottom right,** to return water to the creek. **The total footprint of this project is only 216 sq. ft. Most of this project has already been finished under permit # 96-08951.** Even the power house color is the same.

The **finished items include the tail-works, the power-house/foundation, turbine & and the head-works.** Much of the penstock (pipeline) has been buried, including going under an access road (to well), protected by a 10" steel pipe sleeve, 20 ft. long. More project pictures are found throughout this booklet.

It seems a shame to have facilities that are currently standing idle & useless that could be providing substantial amounts of **clean, green, totally renewable, alternative energy.** This system could be producing up to 10kw x 24 hrs./day x 30 days = **7200 kilowatt hours/month.** Enough energy for 6 homes @ 1200 kwh/month. **At current value** of \$.0805/kwh = \$579/mo. x 8 mo. = \$4632, **2 mo.off,** & 2 @ ½ pwr. = \$579. For a **total \$5211./yr.** System costs of less than \$10K - **make this is a very good investment!**

Introduction continues next page.

Sect. 8, 1/4 Corner, Brass Caplead Wks.

Prop. Corner

Homesite

Power Hse. Power Hse.

Prop. Corner

Prop. Corner

Delt

200

© 2009 Tele Atlas

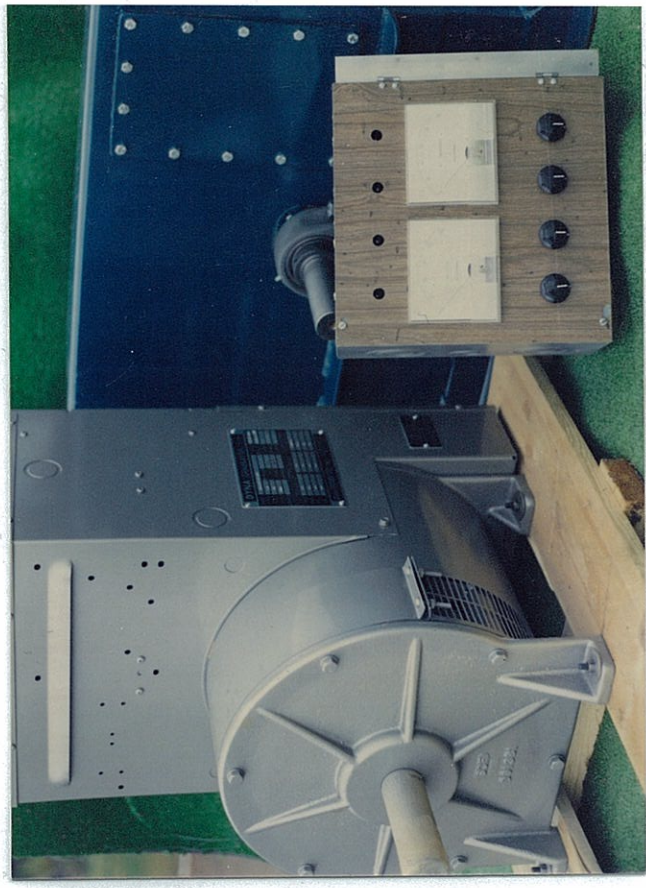
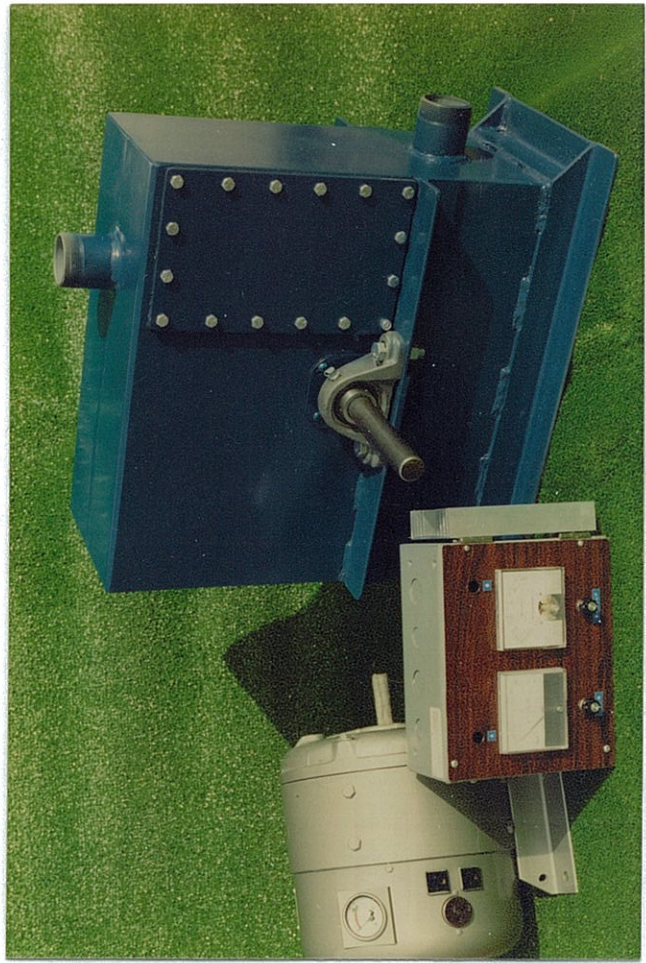
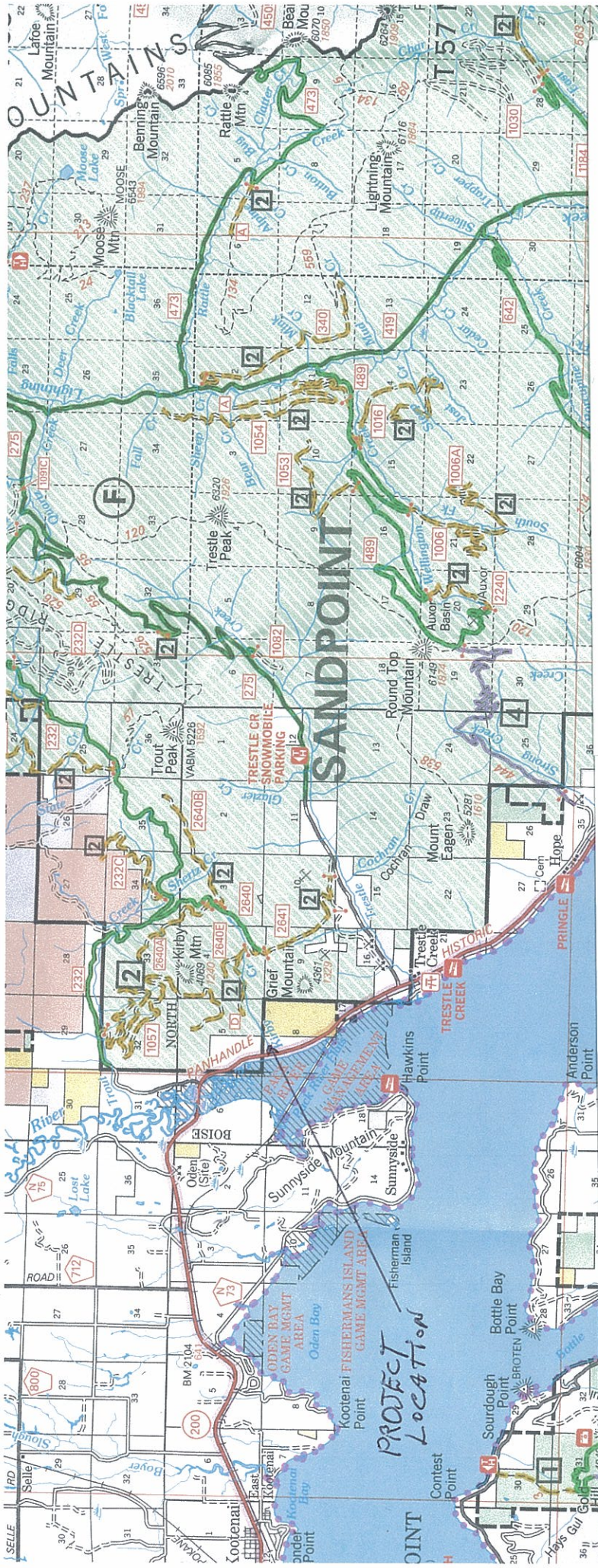
©2009
GOC

We are aware of this application being SUBJECT to the following conditions.

1. All current regulations apply & new priority date would be established.
2. Any prior, properly recorded, water rights of others that are legal & duly recognized by the State of Idaho and which are up-stream of applicant's property. Those properly filed & recognized rights downstream that would be adversely affected by this small-hydro system's beneficial non-consumptive use.
3. That non-consumptive water use permits are subject to consumptive use permits.
Watershed restrictions & national forest make water right conflict unlikely.
4. That Idaho Fish & Game must sign off on this project again.
5. Sufficient quantities of water in Kirby Creek. Voluntary minimum stream flow will be maintained. Since **we also have Avista electrical power** and own the property on both sides of the creek, we have no intentions, need, or desire to dry up the creek, it would ruin our enjoyment of it. **The hydro-power system will be shut down for the IDWR/IDFG mandated stream flow or its natural flow if less.**

"Answer" to "why wasn't project finished in previous permit"? In a single word **"DELAY"**. **Weather delay** from deep winter snow on steep access, ground saturation from spring run-off, rain storms, and fall rains. **We have learned** that ground saturation and possible erosion are much greater on steep ground. **Weather effectively reduced the time window of project work to about 90 days (Aug. to Oct) each year.** Much of one year's delay was spent building forest fire line to protect from a nearby forest fire.

Competing responsibilities delay. During the permit/extension period, **delay was incurred from unanticipated moving twice.** Upon the sickness and death of a family parent, being the only family in the area, **we moved to parent's property**, which **lacked working sewer**, installed pump/tank + 200' line to city sewer. Care-took, probated, cleared title, & sold (3 years). Delay from running a full time business (Wallace' Auto) with employees & remodeling space over shop for living quarters. **Our original plan had been to sell our home for working capital & live above the business installing utilities FIRST.** A **rare** chance to sell the business caught us between the need of equity \$\$ to develop the project property and the need to make a living. Before moving to the property could be completed, an access road, home site, & utilities of septic, electrical power & water system had to be completed, as well as moving a manufactured home to the property. **Too many competing responsibilities "delayed" the hydro system.**



Page 4

Jurisdiction of Federal Energy Regulatory Agency (FERC) This project is exempt from their jurisdiction for the following reasons.

1. None of this project is located on public land.
2. This project is Not located in or on a navigable stream.
3. This project does not use any water impounded by any Federal Dam.
4. This project is a small conduit hydro.
5. This project's impoundment dam (2 ft.) is less than 10 ft. on toe side of dam.
6. This project is under 10 kilowatt power output.
7. All power produced will be consumed on site.
8. **Previous, Identical Project was declared FERC exempt.**
Applicant has already built the identical system as a jointly sponsored, public demonstration project with the Dept. of Energy (DOE). Copy of 1980 Appropriate Technology Small Grants Program - Project # 2-80-056 **Copy upon request.**
9. **All previous projects were declared FERC exempt** that applicant provided consulting, engineering, & product manufacturing services for, including multiple sites in Idaho and Montana. See pictures of actual system packages sold (4kw & 9kw) at left. Products in the pictures & Demo project 2-80-056 are **still running, 22-27 years later.**

Hydro project location

See U. S. Forrest Service **map on facing page for general location** of property. Legal description of location shown on ownership documents, deed & Certified Bonner County Tax Map in "Attachments" Pages A 3, 4

Applicant's property borders on the East to BLM managed public lands. All of the **watershed consists of restricted access public land as shown** on the U.S. Forrest Service map copy, shown on facing page. In considering culvert size to cross Kirby Creek, (to access our property N. of Kirby Cr.) the Natural Resource Conservation Service (NRCS) have determined that the watershed acreage is between 1200 & 1500 acres.

ATE WILDLIFE MANAGEMENT AREA
PACK RIVER FLATS

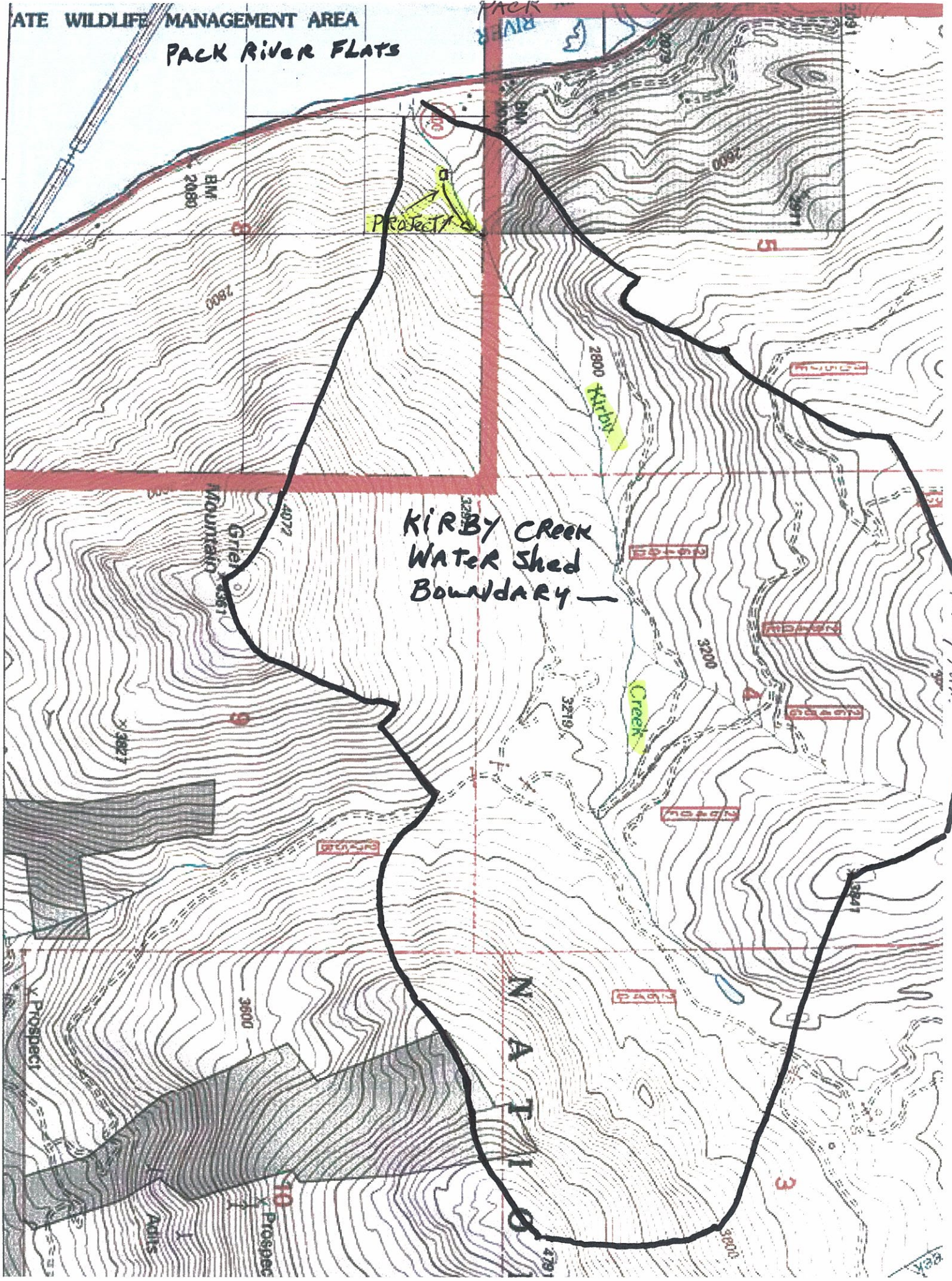
116°22'00" W

Prospect

KIRBY CREEK
Water Shed
Boundary —

WGS84 116°20'00" W

N
A
T
I
O
N



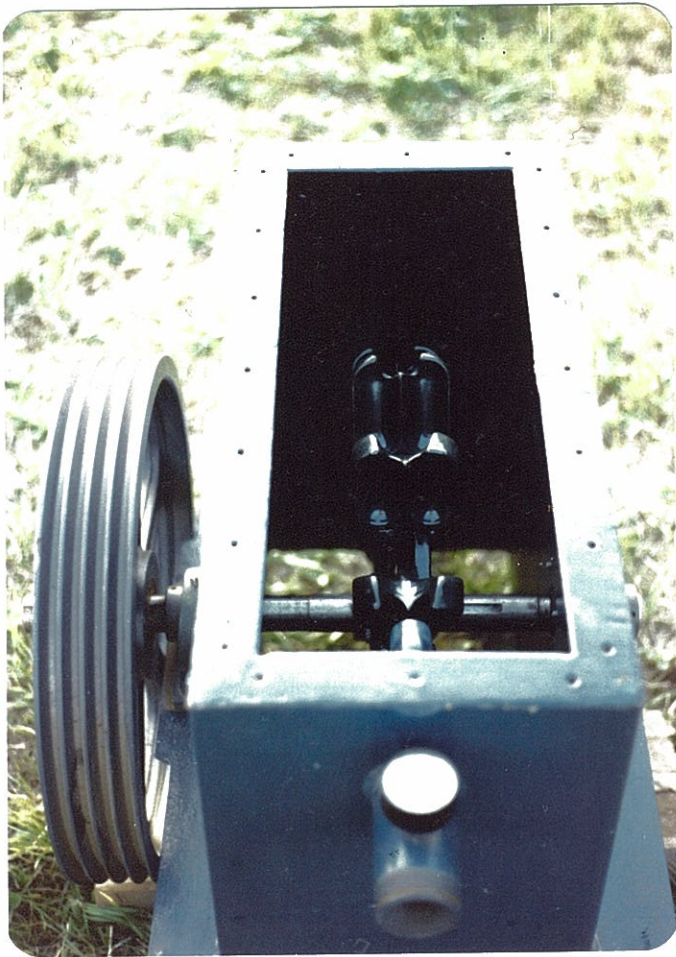
*****Watershed boundaries are shown on topographical. map at left.*****

Why Is This Project is Needed?

1. To **provide clean heat, preserving winter air quality** from wood smoke.
2. To **free up to 2680 kilowatt hours monthly demand** from Avista electrical grid.
3. To **provide alternative energy** as encouraged by Fed. & State Governments.
4. To **promote economic activity in Idaho** from installations, products sales/service.
5. To **encourage Idaho Residents** to use their abundant, sustainable, natural resources of rain & snow. **Inclement weather can make the sun shine - electrically!!!**
6. To **increase our income by reduced energy demand** for “**stimulus**” spending \$\$.
7. To **increase U.S. energy independence, one project at a time.**
8. To **increase national security by reducing dependence on energy imports.**
9. To **reduce demand on Portland coal fired power plant(s).** (upwind of Idaho)
10. To **“do our part” to reduce acid rain, pollution, & need for radioactive waste.**
11. To **“do our part” in reducing “global warming” from C-O-2, heat, & etc.**
12. To **reduce physical demands during retirement** of cutting & handling firewood.

Any renewable energy project that can accomplish the above in a **continuous, permanently sustainable, environmentally sound** way is desirable in as many locations as possible.

Next, we consider **the environment and its protection.**



Environmental Considerations for the Project

A. Air quality is fully protected because only gravity (causing the water weight) is collectively used in producing hydro-power. No heat is generated from burning fossil fuels or coal in making up to 20 horsepower. **No air pollution** of smog or acid rain are caused. **No global warming is caused** thru release of carbon, C,O,-2, or carbon monoxide & etc. and **no waste products are created.** **NO WATER IS CONSUMED!!**

B. Water quality protections taken by applicant for proposed project.

1. Penstock is **NSF (potable water) approved and stamped, picture facing pg. 9.** **Silt fence & settling pond on access road protect** from any summer storm erosion.
2. Penstock pipeline was being buried in an old pre-existing road/skid trail 75-100 ft. away from stream. Installation has been done carefully with ground restoration and “water bar” drainage being done at the end of **each Aug-Oct. construction season.** This reduces or eliminates chances of increasing the TMDL of silt or soil into the creek.

NOTE*: *In summer heat, WATER IS COOLED in 1000 feet of buried pipeline.

3. **Water touches nothing that is not FDA approved in the system.** Turbine shaft is stainless steel. Turbine runner is coated with “Elastuff” 504, an **FDA approved coating** for food contact handling equipment. It is very resistant to abrasion from silt laden run-off water. Photo of coated turbine runner on facing page (top left), uncoated top right.
4. **All other parts, head-works, tail-works, and control valves are standard steel & galvanized such as are found in contact with potable water in every state. The head-work’s stream impact is less than a culvert. A culvert does not allow light or aquatic life, have stream bed, or compensate for streambed lost.**

Note: The water to rust contact in our system is miniscule in comparison to all the steel well casings, & support pilings of highway/railroad bridges in Bonner county. Rust is iron oxide & causes a slight hardness of water. **Iron occurs naturally, is found in nearly all N. Idaho water, and evidently not detrimental to potable water supplies.**

C. Noise protections are incorporated by insulating the power house for sound deadening and adding a truck mud flap on tail-works to trap any turbine noise that tries to escape. Tail-works photo on facing page, bottom. **These systems are very quiet.**



Fish, Fish Migration and Aquatic Life - See creek pics 1-12 in Attachments Pg. A 6-8

Kirby Creek rises in altitude 200+ ft. over 880 ft. of property boundary. See North line on ownership & legal description in Attachments documents. There is one water falls at least **10ft. High just above head-works**, and a water falls of 4-5 ft. just below head-wks. & solid bed rock without any pools where the creek spreads out some 15 ft. wide and 2 to 3 inches deep, **aerated** & flowing very fast. **It seems this creek cannot be a fish migratory stream.** Fish need solid water of sufficient depth to swim and sufficient resting pools below stream falls to move upstream. Having watched this creek carefully since 1996, **unfortunately we have found no fish in or attempting to migrate** up or down the stream in any season of the year. See picture # "12" for 10' falls just above head-wks location & the **highest** water in picture # "11" for 4' falls, just below head-works. **Fish ladders would be incorporated in projects with fish in the stream.**

Aquatic life is protected by maintaining minimum mandated **or natural stream flow** and 3 tributary water confluences that contribute to the creek **below** the head-works water intake. The head-works **protect aquatic life by screening (1/4" holes) out of system all such life of any size** over 1/4 inch. Excess creek water flows into the head-works in the wide low area and continues on till the water level is at 2 ft. depth at which level the water continues through the channel and back to the creek.

Aquatic life are further protected by the LARGE SIZE of the screening area. Note how water flowing past the screen naturally **self cleans**. The screening area is 2 ft. high X 11 1/2 ft. long or **23 square ft.** **The larger the screen the slower the water flows thru it and the less likely it will hold debris.** See picture, top right, on facing page. Walkways protect stream banks. Pictures, lower L & R .

Water flow speed through the screen can be figured from penstock speed which would be a maximum of 4.5 ft. per second through 8" pipe. The cross-section **area** of the pipe is (pie x radius squared) = 50.24 square inches times the **length** in inches (54) for 2711 sq./cubic inches, divided by 144 (sq. inches in a sq. ft.) to convert to sq. ft. of 18.82 @ 1" deep. So, in plain English comparing 18.82 sq. ft. with the 23 sq. ft. of the screen it can be seen that the maximum speed of the water through the screen would be 20% less than 1" per second because the 23sq. Ft. is 20% more than 18.82. Thus the **maximum speed of the 1.5 CFS through the aquatic screen for 23 sq. ft. of screen couldn't be over 1" per second or about 5 ft. per minute.** This **slow speed would be cut in half in summer** due to using 1/2 the water. **2 1/2 ft. per minute when aquatic life is most active.**



Stream Bed Modifications

Stream bed modifications are minimal with removing some larger loose rocks to smooth stream bed. **No stream bed modifications of this project exceeded installing a culvert in crossing any stream.** No motorized equipment were used in or very near the stream. Head-works were previously manufactured off-site by applicant and additional photographs are shown on "picture page", facing page 7.

Again, **I want to stress that this head-works is less invasive to the stream than any culvert.** **With light from the open top, aquatic life that may be washed into the head-works, will have added stream bed in which to live.** **Aquatic life cannot live in a culvert & a culvert cannot be stream bed.** The walkway & safety railing around the top **keeps service foot traffic off creek bank.**

The business end of the head-works has a 10" gate valve to close down the system and drain the penstock if necessary for minimum stream flow or repair. 10" steel pipe (for strength) continues about 50 ft. away from head-works & creek, where it is converted to 8" PVC, NSF, drinking water quality pipe. There is also a 6" clean out to flush settled out silt from run-off. **Note: Water speed for 10" pipe is ½ of 8" or 2.25 ft./second.**

Project Soil Disturbance and Restoration

Soil disturbance from tail works, powerhouse foundation, & much of the penstock is already finished under the previously granted permit (# 96-8951), now expired. Compare 2 tail-works photos, bottom left with soil disturbed from ditch dug and tail-works set in place to bottom right after soil disturbance & restoration. The penstock (pipeline) is being located in the road bed of a previously developed access road and **soil disturbance from penstock installation is finished after each 20ft. Length of pipe is installed.** There still remains several hundred feet of pipeline to finish penstock installation. Additionally, all **disturbed soils are being planted** with a recommended grass mix developed by U.S.F.S. for steep ground & skid trails. **Silt fencing and two settling ponds will be used to control any possible erosion from a summer storm during the yearly pipe installation window of Aug-Oct.**

More photos of project soil disturbance & restoration continue on next page. Most of that disturbance has already been restored. Some soil disturbance remains to be finished and planted around power house. A granted permit will motivate applicant to get busy and finish everything.



Page 9

Project soil disturbance and restoration continued

Top left photo on facing page is of buried pipe as finished after each 20 ft. section of pipe is bedded in sand, covered with more sand and top soil replaced and smoothed. We then plant it to a special grass seed mix for steep ground that is working well to stabilize disturbed soil, **except where the pipeline is in road way**. Where pipeline is under roadway Wood's Crushing crushed rock (1¼ minus) with "binder" controls erosion.

Bottom left photo is close up from top left photo showing the writing on the pipe. It is SDR 26, NSF 61 PVC, class 160 psi @ 73 f. The pipeline has gentle sweeping bends and is being buried from 2 to 4 ft. deep, depending on rock below & pipe side profile to maintain a downward smooth flow.

The top Right photo is the access road as finished and **converges with the pipeline** right of way in the green area beyond the crushed rock topping. The green area is a **restored section** of the road after reclaiming it from past neglect but before disturbing for pipeline. The pipeline photo at top left was taken just below & left of the gravel access road shown in top right photo. The Wood's Crushing crushed rock with clay "binder" is being used on all our access roads because it resists erosion and rutting so well.

Bottom right photo is the green area beyond the crushed rock area of the top right photo.

**THE PHOTOS FOR DESCRIPTIONS BELOW ARE ON THE BACK OF THIS PAGE.
TURN THE PAGE FOR THE PHOTO & READ DESCRIPTION BELOW.**

The photos on back of this page are of more soil disturbance and restoration at the project site of the tail works and power house. The lay of the land here is very gentle sloping downward to the power house and tail works, back to the creek. The season is the dry season of August to October to avoid any possible erosion. A small back hoe was used to dig the tail works ditch and set the tail works system in place.

Top left photo on back of this page is of the soil that was disturbed for the tail works system. The rectangular box shaped steel on the near end is the water inlet to accept water from turbine outlet. The rectangular steel on the far end of tail works is the framework to hold the truck mud flap which muffles any noise that might try to travel all the way down head works pipe and back to the atmosphere.

This project is just waiting to be hooked up and turned on!!!



Project soil disturbance and restoration continued.

Top right photo is of the tail works with the rough restoration well under way. Crushed rock with clay binder was used to pack around the tail works. The clay helps seal any water movement for erosion possibility & the crushed rock packs well and stays in place. The small pipe on the near end of the tail works is for a drain and "P" trap for power house floor.

The bottom left photo is of the rough finished tail works restoration and preparation for the power house footings, foundation and floor. Again, crushed rock was used to fill in and level for footings & foundation. Notice all that beautiful, dry summer weather. There was a lot of waiting for this type of weather to perform this part of the project.

The bottom right photo is of the forms for the concrete footings, foundation, & floor. Transit leveling and tape measure squaring are being done here. Rest of stem wall forms are being built on top of footing forms. Concrete pour was done in a **single pour that tied in the footings, stem wall and floor into a single, very strong foundation system**. Final finish restoration & vegetation restoration need to be finished as soon as the pipeline is tied into the 8" X 6" pipe reducer that goes through the concrete wall to hold back the **ring seal pipe** from coming apart from the 85 psi pressure.

The pressure against the building foundation will be product of the 8" pipe **cross section area** times pie (pie R squared) $16 \times 3.1416 = 50.26$ sq. inches, times 85 psi for a total pressure of 4,272 pounds against the foundation. **Pressure can easily increase up to double or more**, depending on speed the system is shut down. **It is "water hammer"**.

The tail works, power house/foundation, head works, & much of the pipeline are finished and whether a permit is issued or not it remains, waiting to be finished. Waiting to be put to beneficial use for all concerned. See public benefits.

Archeological, Anthropological and Endangered Plants and Animal Species .

In applying for a right of way to develop a spring (unrelated to hydro) on BLM managed public land (2005 & 2006) **BLM have sent up 4 or 5 different research folks from various government agencies to do investigations in this area for possible archeological & anthropological sites indicating Indian activity, camp sites, rock carvings or burial grounds and found none.**

Archeological, Anthropological and Endangered Plants/Animal Species - cont.

BLM & NRCS conducted research on possible conflict with threatened & endangered native plants or animals in the area & found "Moon Wart" plants in a neighboring watershed. They supplied me with an aerial photo. BLM & IDWR issued permits for the spring but development was halted due to water pollution from shallow soil and too fast of water movement through it. A well had to be dug, its water permit is currently on file at IDWR.

This hydro project doesn't adversely affect any animal species because of its small footprint which does not restrict their movement, it doesn't affect the water they drink, the air they breathe, the temperature they live in, or the sounds they hear.

Conclusion: This Watershed's Future Looks Good & LIKELY TO STAY THAT WAY in perpetuity. It is very likely that there are other hydro sites that if carefully sited and developed could add tremendously to energy independence, reduce demand on the public power grid, and make residents more aware of their power use and thus more conservative of that resource.

PUBLIC BENEFITS - Public Environmental Benefits

There are so many public environmental benefits from this project (and others that could result from it), that I don't know if I can name them all.

1. No natural resources are consumed.
2. No heat is generated from burning fossil fuels.
3. No air pollution or acid rain is caused.
4. No expensive new technology is needed or decades to develop it.
5. No global warming is caused, No Co2 is generated or carbon released.
6. No birds are struck from windmill blades & No views are ruined.
7. No waste products are generated.
8. No expensive power lines are needed.
9. No loud noise is made.
10. NO WATER IS CONSUMED or POLLUTED.
11. Water is cooled from being underground for 1000 ft.

Continued

Page 12

12. Winter air quality is protected or improved from less wood stove smoke.
13. Reduce demand from the public grid of up to 2600 kilowatt hours per month.
14. Increase U.S. independence by reducing dependency on fossil fuel imports.
15. Increase U.S. energy independence one project at a time.
16. Improve air quality by reducing demand on Portland coal fired power plants.
17. Reduce global warming as a result of all the above.
18. Demonstrate, clean, renewable, "green", carbon & CO2 free energy.
19. Provide electrical power for an electric vehicle.

Hydro power is extremely clean, green, permanently renewable. Hydro power also works 24 hours per day, on windless days, dark winter days, & at night. The total public benefits would depend on number of systems installed.

It is the purpose of this expanded information to help Idaho governing agencies to see the possibilities of using natural resources in a environmentally responsible way.

Public Economic Benefits

Again, the public economic benefits, like the environmental, are many and varied. If Idaho were to promote its natural resources of snow & rain in small hydro there could be huge benefits. Top quality paying jobs would be created from environmental consulting, designing, & engineering jobs, equipment & installing jobs, electrician, maintenance and service jobs of these power systems.

Behind the scenes would include manufacturing jobs for the products used in these systems of generators, turbines, pipeline, construction steel, sheaves (pulleys), belts, governors (electrical & mechanical) electrical wire, conduit, monitoring meters, building materials, concrete, and a lot of secondary service jobs to support the primary jobs such as restaurant, motel, & transportation jobs. The list could go on to purchases from job income such as new vehicles, real-estate, clothing and etc., etc.

Public Economic Benefits cont.

The **public would benefit from the economic activity of all the above, which would increase taxable income from those jobs, which would increase Idaho State & Federal Revenues from income tax. It would increase the valuation of properties and thus the tax base for local government & schools.**

There could be **public savings from energy price stability** thru private sales to the grid, producing **income for producers**, further increasing Idaho's taxable income. The public could also benefit from the **savings of not needing as many new, expensive, power lines, savings from "cap & trade" rate increases, savings in electricity costs,** for those who invested in their own power systems, **savings in an investment that cannot be easily stolen**, that truly has a short & long term payback. **Savings in individual energy use** from being involved in energy production and much more aware of energy use. **Savings in the balance of the national trade deficit** thru lessening imports.

What is needed is for Idaho government to get the VISION of leading out in developing the framework to properly site & install small hydro systems as well as wind mills and **be the leader in promoting totally clean, alternative, permanently renewable, energy as encouraged by Fed & State Govt.** Which collectively could **decrease energy imports** which **increases national security & may reduce global warming.** **What better vision could there be for Idaho's economic future?**

The time needed to finish this project is about a year of construction & soil restoration time. However, at only 90 days of pipe-laying window each year that will take four years. Four, 90 day windows = 360 days. Being retired & moved in we may finish sooner but four years is what we will ask for. **We can now finish with "due diligence".**

I want to take this time to thank those involved with this permit process for their time in having read & considered this complete application. In my opinion this application is what ought to be filed & followed in installation of small or micro hydro systems. The archeological & anthropological section might be "over kill" but I had the information available, so why not include it. It may not apply when the project is completely on private land.

IDAHO COULD BE A NATIONAL LEADER IN ALTERNATIVE ENERGY.



Public Benefits History of Applicant's Past Projects

The first hydro-electric project the applicant performed was a public demonstration system installed on the South Fork of Grouse Creek, also known as Strawberry Creek. That project was a jointly sponsored project with the Department of Energy. Project number 2-80-056, Copy available. That project was finished on time, on budget, and if my memory serves me correctly, generated over a thousand inquiries through letters and visits, including a visit from KXLY news team. **All pictures on these pages are from that demonstration system.**

The project was very successful and is **still running 27 years later.** Additionally when we sold the property we received all of our investment \$\$ back & a profit on our investment PLUS we had totally free electricity (1500kwh monthly) for 6 years. Energy production investments can pay off and cannot easily be lost in financial markets. **What is the \$ value of 27 yrs. energy production? 1500 metered kwh x 324 months = 486,000kwh @ \$.0805 (current Avista price)= \$39,123.00 Grid savings = ½ megawatt**

Example projects that the Applicant provided goods & services for are shown in actual pictures on the facing pictures, page, 4. They were a 4 kw system package located in Athol and a 9 kw system package located just over the border in Montana from Troy Id. These systems are all still in operation over 22 years later. Value of 9kw for 22 yrs.? **9kw/hr x 8760 hrs/yr x 22 yrs = 1,734,480kwh @ \$.0805 (Avista) = \$139,625.64 value.**

I was producing alternative energy & products when alternative energy wasn't cool.



STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

AFFIDAVIT FOR WATER RIGHTS TO BE USED FOR POWER PURPOSES

A. Establishment of Residency: (Complete either 1, or 2).

1. Individual Applicant or Individual Members of a Partnership:

I, R. Lloyd Walker of HOPE ID,
(name) (city)County of Bonner, State of Idaho, being duly sworn, do hereby
certify that I am a bona fide resident of the State of Idaho.

2. Corporation:

I, _____ of _____,
(name) (city)County of _____, State of Idaho, being duly sworn, depose and
say: That I am the designated registered agent of the __________; that as such I am in charge of the registered office of the said
(name of corporation)corporation as required by Section 30-1-12, Idaho Code, at _____
(city)

Idaho, wherein are kept the corporate records required by Section 30-1-52, Idaho Code: and that _____

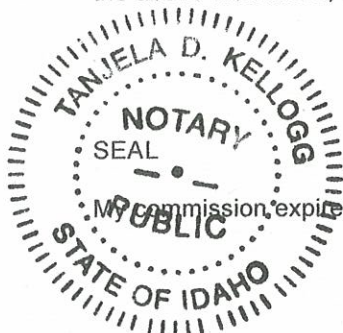
_____, is a corporation qualified to do business in the State of Idaho under the laws
(name of corporation)
of the State of Idaho.

B. Ownership of Facilities: (To be completed for hydropower projects only)

The hydropower facility to be developed pursuant to the attached Application for Permit:

(check one)

- ☒ Will **not** utilize existing man-made irrigation facilities such as a dam or a canal.
- ☐ Will utilize existing man-made irrigation facilities such as a dam or a canal, and permission of the owner is documented in an affidavit attached hereto.
- ☐ Will utilize existing man-made irrigation facilities such as a dam or a canal, and the owner is the signee of this affidavit.

R. Lloyd Walker
ApplicantSTATE OF IDAHO)
County of BONNER)ssOn this 30th day of APRIL, 20 09, personally appeared before me the signer(s) of
the above instrument, who duly acknowledged to me that he (she) (they) executed the same.Tanjela D. Kellogg
Notary Public residing at
Sandpoint, ID Bonner County

BONNER COUNTY Resident SINCE 1952

57978

A4

494031

WARRANTY DEED

For Value Received

CRAIG D. MUNKEBY, an unmarried man

The grantor, do^{es} hereby grant, bargain, sell and convey unto Lloyd and Alice Wallace Living Trust, R. Lloyd Wallace and Alice M. Wallace, Trustees

the grantee^s whose current address is 1005 N. 5th Ave
Sandpoint, ID 83864
 the following described premises, in Bonner

County Idaho, to-wit:

A parcel of land lying in a portion of the Northwest Quarter of SECTION 8, TOWNSHIP 57 NORTH, RANGE 1 EAST, Boise Meridian, Bonner County, Idaho, more particularly described as follows:

Beginning at the North Quarter corner (N1/4) of said Section 8, a found B.L.M. brass cap, monumenting said corner, which bears South 89°13'15" East, 2662.54 feet from the Northwest corner of said Section 8;
 THENCE North 89°13'15" West, 888.08 feet, along the North line of said Section 8, to a point;
 THENCE leaving said North section line, South 00°46'45" West, 888.54 feet, to a point;
 THENCE South 77°59'02" East, 913.06 feet to a point of intersection with the North-South centerline of said Section 8;
 THENCE North 00°22'40" East, 1066.49 feet, along said section centerline, to the Point of Beginning.

ALLIANCE TITLE
 FILED BY
 36 OCT 24 PM 3 42
 M/NE SCOTT
 RECORDER BY BONNER
 COUNTY CLERK
 DEP.

COPY

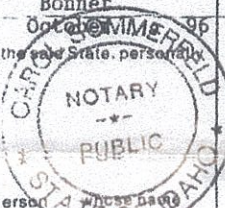
TO HAVE AND TO HOLD the said premises, with their appurtenances unto the said Grantee^s their heirs and assigns forever. And the said Grantor do^{es} hereby covenant to and with the said Grantee^s that he is the owner in fee simple of said premises; that they are free from all incumbrances EXCEPT: current year taxes, conditions, covenants, restrictions, reservations, easements, rights and rights of way, apparent or of record

and that he will warrant and defend the same from all lawful claims whatsoever.

Dated: 10-24-96

Craig D. Munkeby

STATE OF IDAHO, COUNTY OF Bonner
 On this 24 day of October 1996
 before me, a notary public in and for the said State, personally appeared
 Craig D. Munkeby



known or identified to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same.

Residing at Sandpoint
 Comm. Expires 03/01/99

STATE OF IDAHO, COUNTY OF
 I hereby certify that this instrument was filed for record at the request of

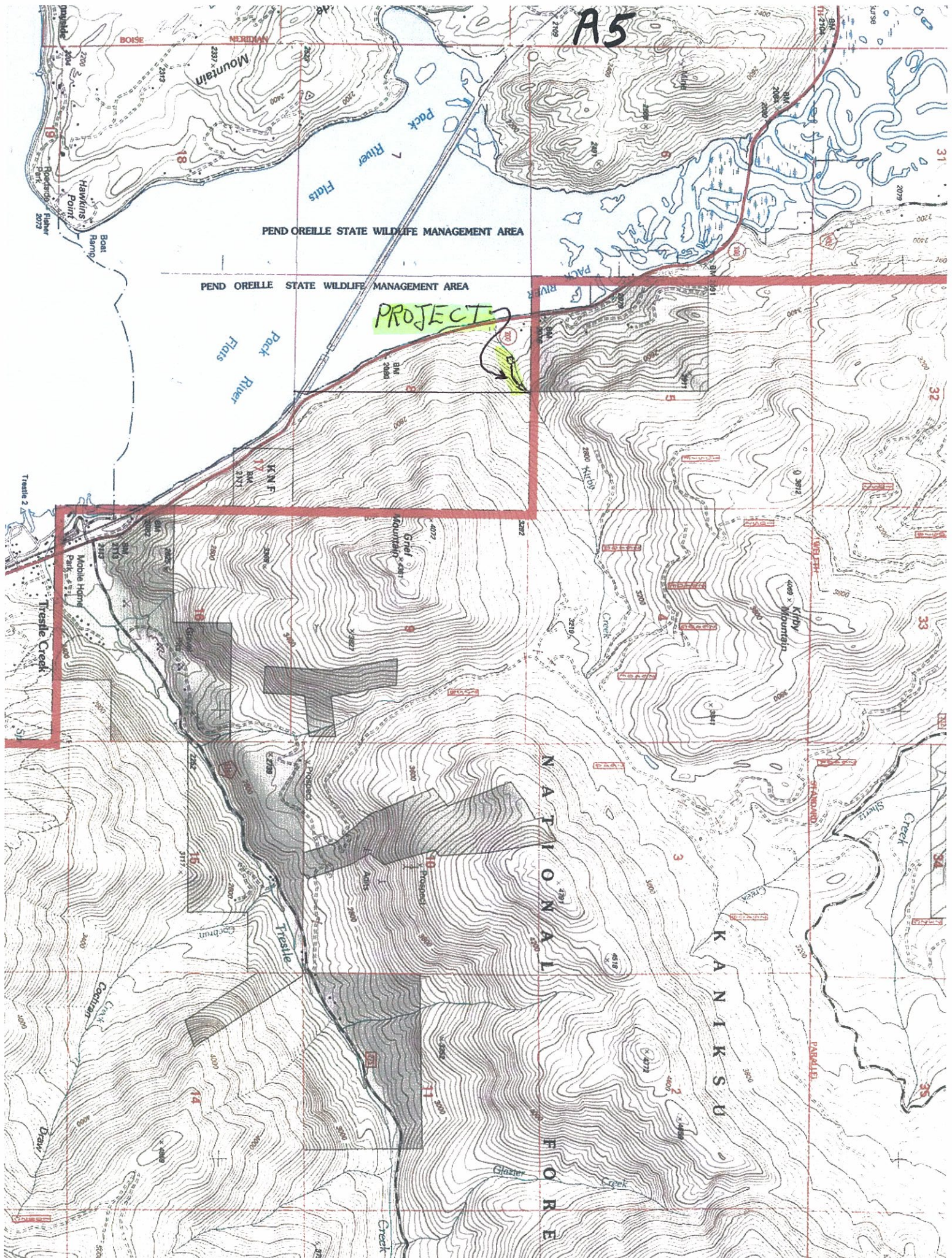
this minutes past o'clock M.,
 day of
 in my office, and duly recorded in Book
 of Deeds at Page

Ex-Officio Recorder

By Deputy

Fees \$
 Mail to:

Grantee





Attachments page 6

Creek photos # 1 - 12

Introduction: When viewing these photos keep in mind that if you can read the photo number in its normal or upright position, you are viewing it as it is on the ground. The photo numbering is from 1 thru 12 and starts at the tail works. As the numbers increase so does the altitude and work their way up the creek to the head works. These pictures were taken April 10, 2009 and are about what a normal run-off would be. There have been larger run-offs. The larger the run-off the more violent and aerated the stream becomes.

Photo # 1 is at the tail works or lowest part of the hydro project. Look carefully at the lower right hand corner and the tail works can be seen. There is one set of water falls after another with the largest being between 3 & 4 ft. This part of the stream is flatter and maybe fish could work their way up to here. No stream modifications were or will be needed.

Photo # 2 was taken just beyond where it can be seen in photo 1 and looks up the stream as it makes a sharp left and then a sharp right corner. Just around the right corner the creek comes back together from a split further up stream. The water drops about 10 - 15 ft. in this photo.

Photo # 3 was taken just around the corner from # 2 and is of the N. fork of the creek split mentioned above. It has a water drop of about 15 - 20 ft. and has a lot of dead debris in it. It also fully dries up just after run-off. This fork goes through so much old washed in debris that it looks impossible for a fish to get through it. There are no pools.

Photo # 4 is the S. fork of the stream split mentioned in photo 2 description. It is the main body of Kirby Creek. It has multiple water falls 4-6 ft. high. The real problem here to fish migration is the lack of resting pools and the frothy, aerated water.



Attachments page 7

Photo #5 is just at the highest point seen in photo 4 and has 2 major water falls in it. One is about 4 ft. high and the other is over 6 ft. high. At the highest water level that can be seen is the area where the creek splits as mentioned in photos # 2, & 3.

Photo # 6 does not “do justice” to the steepness of this area. The creek falls about 30 ft. over an 80 ft. distance. It is totally frothed with no solid water and no resting pools.

Photo #7 Rotate picture 90 degrees right to view properly. This photo was taken upstream from photo 6. The falls in this photo is over 6 ft. high, fully aerated and very little if any resting pooling. The water here is again coming together from an upstream split. The beauty of these moss covered rocks is evident.

Photo #8 was taken about 40 ft upstream from picture 7. Careful observation should show some of the same landmarks in both photos. Here there are root wads, debris, fully aerated and very fast moving water. There are no resting pools. The stream splits and comes back together shown in photo 7.



Attachments page 8

Photo # 9 begins an area that is mostly solid rock spreading the water out to a few inches deep but very fast moving and fully aerated. There are no resting pools or solid water for fish to live in. Debris strains out other debris until it all moves down stream.

Photo # 10 is of solid bed rock about 20 ft. wide with the water spread out and very shallow, fully aerated and moving fast. This area of the creek continues for about 80 ft. in this photo. At the top of this photo is a 6ft. Waterfalls. There are no resting pools here.

Photo # 11, Rotate photo 11, 90 degrees right. It has a resting pool or two at the bottom but the water is in near continuous falls and fully aerated. Find the highest water falls in the picture for the 4 ft. falls just below the head-works. There it also spreads out over bedrock about 15 ft. wide and for about 20 ft. down stream, fully aerated and running fast.

Photo # 12 is of the 10 ft. falls just above the head-works. Here too there is no resting pool of solid water. Actually there is another 2-3 ft. falls just out of sight and yet nearly part of this falls. So the total altitude a fish would have to jump is about 12 ft. high.

To me it looks like this stream cannot be a stream with fish migration. We have watched this stream since we bought it in 1996 and haven't seen any fish. If this project was proposed for a stream with fish in it we would add a fish ladder system.

This ends the stream pictures which cover the whole stream in this project.



United States
Department of
Agriculture

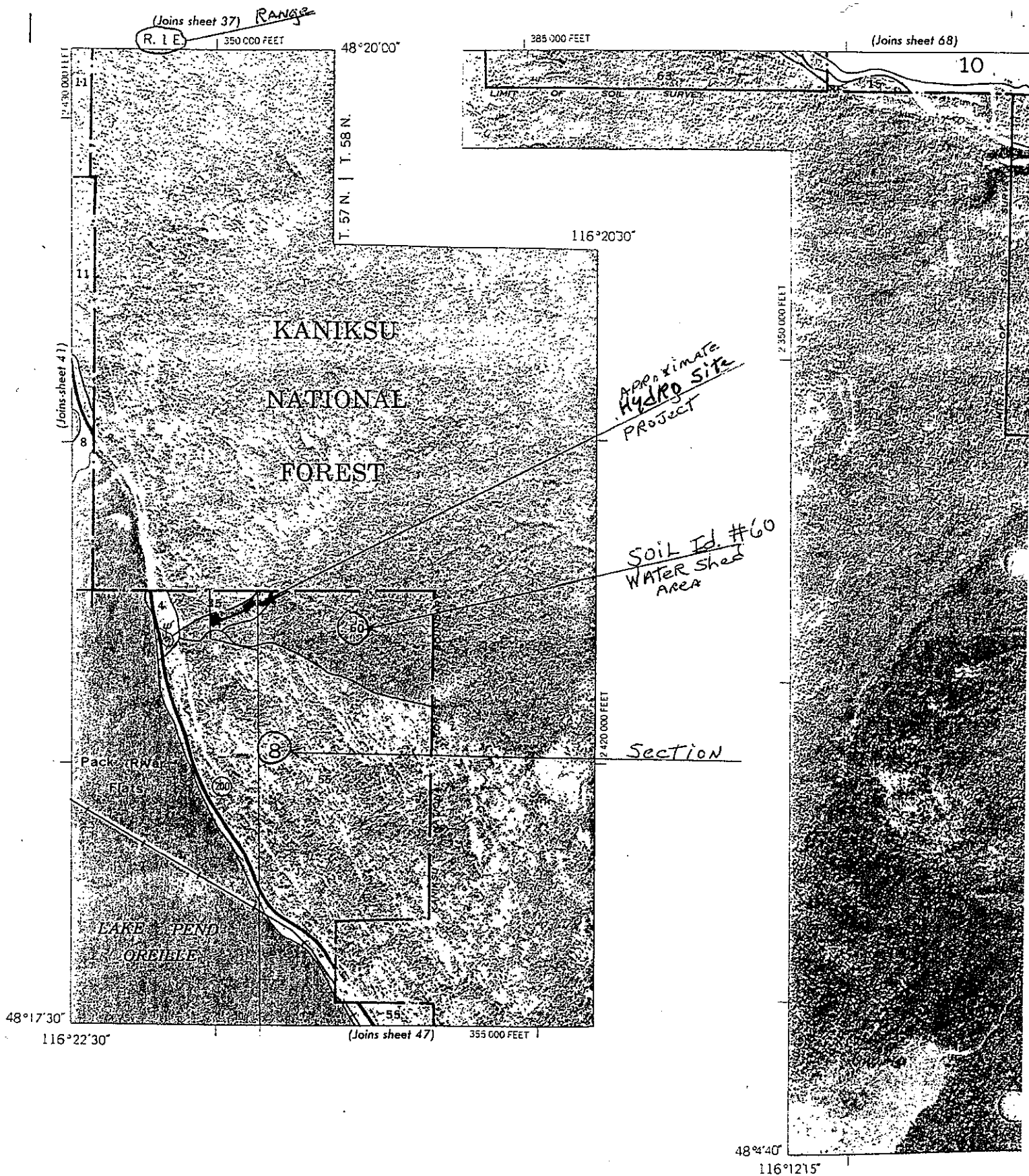
Soil
Conservation
Service

A
In Cooperation with
the University of Idaho,
College of Agriculture,
and the Idaho Soil
Conservation Commission

Soil Survey of the Bonner County Area, Idaho

Parts of Bonner and
Boundary Counties, Idaho





48°4'40" N
116°12'15" W

unit has few limitations for harvesting timber. If are constructed on the unit, slumping of cutbanks is expected.

Livestock grazing.—This unit can produce forage for livestock and big game animals for 10 to 20 years after the canopy is opened by logging, fire, or some other disturbance. During this period, annual production of forage ranges from 1,800 pounds of air-dry vegetation per acre to less than 100 pounds per acre as the canopy closes.

Recreation.—Most areas of this unit are poorly suited to recreational development. Steepness of slope limits use of these areas mainly to a few paths and trails, which on this unit should extend across the slope.

Cuts and fills on this unit, however, are areas of more nearly level soils that are more suitable for use as recreational sites. Cuts and fills on this unit should be seeded or mulched.

Homesite development.—Most areas of this unit are poorly suited to homesite development. The main limitation is slope. Included in this unit, however, are areas of more nearly level soils that are more suitable for use as homesites. Onsite investigation is required to evaluate these areas.

Watershed.—This unit should be managed to keep soil erosion to a minimum, which helps maintain its value as watershed. Soil erosion can be minimized by careful management of the timber and understory vegetation on the unit.

This map unit is in capability subclass VIe and in woodland suitability subclass 1f.

Soil ID. # 54

Treble gravelly sandy loam, high precipitation, 25 to 65 percent slopes. This very deep, well drained soil is on south-facing mountainsides. It formed in glacial till derived dominantly from granite, gneiss, and schist and has a thin mantle of loess and volcanic ash. Elevation is 2,000 to 4,000 feet. The average annual precipitation is 28.5 inches, the average annual air temperature is 43 degrees F, and the average frost-free period is 160 days.

Typically, the surface is covered with a mat of leaves, twigs, and grass about 0.75 inch thick. The topsoil layer is dark grayish brown, slightly acid gravelly sandy loam about 2 inches thick. The upper 5 inches of the subsoil is yellowish brown, slightly acid gravelly sandy loam, and the lower 20 inches is light yellowish medium acid very gravelly coarse sandy loam. The substratum to a depth of 60 inches or more is unconsolidated, medium acid very gravelly loamy coarse sand.

Permeability of this Treble soil is moderately rapid to a depth of about 27 inches and moderately rapid to rapid below this depth. Effective rooting depth is 60 inches or more. Available water capacity is very low to low. Runoff is rapid, and the hazard of water erosion is very high.

Soil ID. #

Included in this unit are small areas of Priestlake gravelly sandy loam, Jeru very stony sandy loam, warm, on north-facing side slopes; Hun gravelly silt loam at the higher elevations on mountainsides; Klootch gravelly sandy loam on north-facing side slopes; and Rock outcrop on ridges and knobs.

Most areas of this unit are used for timber production, wildlife habitat, recreation, and watershed. A few areas are used for limited livestock grazing.

Woodland.—Grand fir, western white pine, and Douglas-fir are the main woodland species on this unit. Among the trees of limited extent are ponderosa pine and western larch. On the basis of a 50-year site curve, the average site index for grand fir is 70. On the basis of a 100-year site curve, the average site index for Douglas-fir and ponderosa pine is 105. Yield tables indicate that the maximum average annual growth is 135 cubic feet per acre of grand fir at 105 years of age and 112 cubic feet per acre of Douglas-fir and ponderosa pine at 40 years of age.

The main limitations for the harvesting of timber are slope and the hazard of water erosion. Steepness of slope restricts the use of wheeled and tracked equipment in skidding operations; cable yarding systems generally are safer and disturb the soil less. Steep yarding paths, skid trails, logging roads, and firebreaks are subject to rilling and gullying unless adequate water bars are provided and plant cover is reestablished. If roads are constructed on this unit, slumping of cutbanks can be expected.

Livestock grazing.—This unit can produce forage for livestock and big game animals for 10 to 20 years after the tree canopy is opened by logging, fire, or some other disturbance. During this period, annual production of forage ranges from 1,800 pounds of air-dry vegetation per acre to less than 100 pounds per acre as the canopy closes. Slope may create livestock distribution problems.

Recreation. This unit is poorly suited to recreational development. Steepness of slope limits the use of areas of this unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched.

Homesite development.—This unit is poorly suited to homesite development. The main limitation is slope.

Watershed.—This unit should be managed to keep soil erosion to a minimum, which helps maintain its value as watershed. Soil erosion can be minimized by careful management of the timber and understory vegetation on the unit.

This map unit is in capability subclass VIIe and in woodland suitability subclass 1f.

55—Treble-Rock outcrop association, 20 to 65 percent slopes. This map unit is on mountainsides. Elevation is 2,200 to 3,600 feet. The average annual precipitation is about 28 inches, the average annual air

Soil Id. 55 cont.

temperature is about 45 degrees F, and the average frost-free period is about 110 days.

This unit is about 45 percent Treble gravelly sandy loam and 30 percent Rock outcrop. The remaining 25 percent is included soils. The Treble soil is on south-facing side slopes, and Rock outcrop is on ridges and knobs.

Included in this unit are small areas of Lenz stony sandy loam near areas of Rock outcrop on ridges, Dufort silt loam on east- and west-facing side slopes and in concave areas; Pend Oreille silt loam on north-facing side slopes and in concave areas, and Ardtoo gravelly sandy loam on east- and west-facing side slopes.

The Treble soil is very deep and well drained. It formed in glacial till derived dominantly from granite, gneiss, and schist and has a thin mantle of loess and volcanic ash. Typically, the surface is covered with a mat of needles, leaves, and twigs about 0.75 inch thick. The surface layer is dark grayish brown, slightly acid gravelly sandy loam about 2 inches thick. The upper 5 inches of the subsoil is yellowish brown, slightly acid gravelly sandy loam, and the lower 20 inches is light yellowish brown, medium acid very gravelly coarse sandy loam. The substratum to a depth of 60 inches or more is variegated, medium acid very gravelly loamy coarse sand.

Permeability of this Treble soil is moderately rapid to a depth of about 27 inches and moderately rapid to rapid below this depth. Effective rooting depth is 60 inches or more. Available water capacity is very low to low. Runoff is rapid to very rapid, and the hazard of water erosion is high to very high.

Rock outcrop consists of areas of exposed granite, gneiss, or schist. It is fractured in places and has some soil material in the cracks and crevices. Areas of Rock outcrop are not suitable for most land uses.

Most areas of this unit are used for timber production, livestock grazing, wildlife habitat, recreation, and watershed. A few areas are used as homesites.

Woodland.—Douglas-fir and ponderosa pine are the main woodland species on the Treble soil. Among the trees of limited extent are western larch and lodgepole pine. On the basis of a 100-year site curve, the average site index for Douglas-fir and ponderosa pine is 105. Yield tables indicate that the maximum average annual growth for Douglas-fir and ponderosa pine is 112 cubic feet per acre at 40 years of age. The areas of Rock outcrop in this unit will reduce yield about 30 percent.

The main limitations for the harvesting of timber are slope, the hazard of water erosion, and the areas of Rock outcrop. Steepness of slope restricts the use of wheeled and tracked equipment in skidding operations; cable yarding systems generally are safer and disturb the soil less. Wheeled and tracked equipment can be used in the more gently sloping areas. The areas of Rock outcrop may cause breakage of timber and hinder yarding. Steep yarding paths, skid trails, logging roads,

and firebreaks are subject to rilling and gullying unless adequate water bars are provided and plant cover is reestablished.

The seedling mortality rate may be high in summer because of the lack of adequate moisture in the soil. The areas of Rock outcrop limit the even distribution of naturally regenerated tree seedlings.

Livestock grazing.—This unit can produce forage for livestock and big game animals for 15 to 25 years after the tree canopy is opened by logging, fire, or some other disturbance. During this period, annual production of forage ranges from 1,000 pounds of air-dry vegetation per acre to less than 500 pounds per acre as the canopy closes. The production of forage is limited by the areas of Rock outcrop, which can interfere with movement of livestock and accessibility of forage. If the shrubs on this unit are managed to create open areas, the unit produces a good stand of desirable grasses and forbs. Slope may create livestock distribution problems.

Recreation.—This unit is poorly suited to recreational development. It is limited mainly by slope and the areas of Rock outcrop. Steepness of slope limits the use of areas of this unit mainly to a few paths and trails, which should extend across the slope.

Homesite development.—This unit is poorly suited to homesite development. The main limitations are slope and the areas of Rock outcrop.

Watershed.—This unit should be managed to keep soil erosion to a minimum, which helps maintain its value as watershed. Soil erosion can be minimized by careful management of the timber and understory vegetation on the unit.

The Treble soil is in capability subclass VIIe, and Rock outcrop is in VIIIs. This unit is in woodland suitability subclass 2x.

56—Treble, high precipitation-Rock outcrop complex, 15 to 35 percent slopes. This map unit is on south-facing mountain foot slopes. Elevation is 2,500 to 3,600 feet. The average annual precipitation is about 35 inches, the average annual air temperature is about 43 degrees F, and the average frost-free period is about 90 days.

This unit is about 45 percent Treble gravelly sandy loam and 30 percent Rock outcrop. The remaining 25 percent is included soils. The Treble soil is on south-facing side slopes, and Rock outcrop is on convex side slopes and ridges. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Priestlake gravelly sandy loam and Jeru very stony sandy loam, warm, on north-facing mountain foot slopes; Hun gravelly silt loam at the higher elevations on mountainsides; Klootch gravelly sandy loam on north-facing mountainsides; and Bonner silt loam, cool, in benchlike areas.

The Moscow soil can produce forage for livestock and big game animals for 10 to 20 years after the tree canopy is opened by logging, fire, or some other disturbance. During this period, annual production of forage ranges from 1,800 pounds of air-dry vegetation per acre to less than 150 pounds per acre as the canopy closes. Slope may create livestock distribution problems.

Recreation.—This unit is poorly suited to recreational development. It is limited mainly by slope and hazard of water erosion. Slope limits the use of areas of this unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched.

Homesite development.—This unit is poorly suited to homesite development. The main limitation is slope.

Watershed.—This unit should be managed to keep soil erosion to a minimum, which helps maintain its value as watershed. Soil erosion can be minimized by careful management of the timber and understory vegetation on the unit.

This map unit is in capability subclass VIIe. The Vassar soil is in woodland suitability subclass 1r, and the Moscow soil is in 2d.

60—Vay gravelly silt loam, 35 to 65 percent slopes.

This deep to very deep, well drained soil is on mountainsides. It formed in material derived dominantly from granite, gneiss, and schist and has a thick mantle of volcanic ash. Elevation is 3,600 to 4,800 feet. The average annual precipitation is about 40 inches, the average annual air temperature is about 42 degrees F, and the average frost-free period is about 75 days.

Typically, the surface is covered with a mat of needles, leaves, and twigs about 2 inches thick. The surface layer is yellowish brown, medium acid gravelly silt loam about 6 inches thick. The upper part of the subsoil is light yellowish brown and pale brown, medium acid gravelly silt loam and very gravelly loam about 19 inches thick, and the lower part is very pale brown, slightly acid extremely gravelly coarse sandy loam about 17 inches thick. Weathered granite is at a depth of about 42 inches.

Permeability of this Vay soil is moderate. Effective rooting depth is 40 to 60 inches or more. Available water capacity is low. Runoff is very rapid, and the hazard of water erosion is very high.

Included in this unit are small areas of Ardoo gravelly loam on south-facing convex side slopes; Treble gravelly sandy loam on south-facing foot slopes; and Hun gravelly silt loam and Jeru very stony sandy loam, warm, in the higher areas on mountainsides.

This unit is used for timber production, wildlife habitat, recreation, watershed, and limited livestock grazing.

Woodland.—Western redcedar, grand fir, western white pine, and Douglas-fir are the main woodland species on this unit. Among the trees of limited extent are western hemlock, western larch, and ponderosa

pine. On the basis of a 50-year site curve, the average site index is 80 for grand fir and 75 for western white. On the basis of a 100-year site curve, the average site index is 120 for Douglas-fir. Yield tables indicate that the maximum average annual growth is 154 cubic feet per acre of grand fir at 100 years of age, 144 cubic feet per acre of western white pine at 103 years of age, and 141 cubic feet per acre of Douglas-fir at 40 years of age.

The main limitations for the harvesting of timber are slope and the hazard of water erosion. Steepness of slope restricts the use of wheeled and tracked equipment in skidding operations; cable yarding systems generally are safer and disturb the soil less. Steep yarding paths, skid trails, logging roads, and firebreaks are subject to rilling and gullying unless adequate water bars are provided and plant cover is reestablished. Special design for roads is needed to overcome the limitation of slope and the susceptibility of the soil to slumping when saturated.

Plant competition is the main concern in the production of timber. When openings are made in the canopy, invading brushy plants delay natural tree regeneration.

Livestock grazing.—This unit can produce forage for livestock and big game animals for 5 to 10 years after the tree canopy is opened by logging, fire, or some other disturbance. During this period, annual production of forage ranges from 2,000 pounds of air-dry vegetation per acre to less than 100 pounds per acre as the canopy closes. Slope may create livestock distribution problems.

Recreation.—This unit is poorly suited to recreational development. It is limited mainly by slope and the hazard of water erosion. Steepness of slope limits the use of areas of this unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched.

Homesite development.—This unit is poorly suited to homesite development. The main limitation is slope.

Watershed.—This unit should be managed to keep soil erosion to a minimum, which helps maintain its value as watershed. Soil erosion can be minimized by careful management of the timber and understory vegetation on the unit.

This map unit is in capability subclass VIIe and in woodland suitability subclass 1r.

61—Vay silt loam, cool, 30 to 65 percent slopes.

This deep to very deep, well drained soil is at the higher elevations on mountainsides. It formed in material derived dominantly from granite, gneiss, and schist and has a mantle of volcanic ash. Elevation is 4,600 to 5,600 feet. The average annual precipitation is about 45 inches, the average annual air temperature is about 40 degrees F, and the average frost-free period is about 45 days.

Typically, the surface is covered with a mat of needles, leaves, and twigs about 2 inches thick. The

several wavy discontinuous clayey bands about 2 millimeters thick; few dark brown soft iron accumulations 1 millimeter to 2 millimeters in diameter; medium acid (pH 5.8); gradual smooth boundary.

B3t—45 to 60 inches; light yellowish brown (10YR 6/4) loamy fine sand, olive brown (2.5Y 4/4) moist; single grain; loose; few very fine roots; few fine tubular pores and many very fine interstitial pores; several wavy discontinuous clayey bands about 2 millimeters thick; few light gray splotches; few reddish brown soft iron accumulations 1 millimeter to 3 millimeters in diameter; medium acid (pH 5.8).

The profile is medium acid to neutral. Base saturation 30 to 60 percent. Some pedons have a layer of light gray volcanic ash 1/4 to 1/2 inch on the surface.

A1 horizon: Value is 4 or 5 when dry, and chroma is 3 or 4 when dry and 2 to 4 when moist.

B2 horizon: Hue is 10YR or 7.5YR, value is 5 to 7 when dry, and chroma is 3 or 4 when moist. Texture is fine sandy loam or sandy loam.

B3t horizon: Hue is 10YR, 2.5Y, or variegated, and value is 6 or 7 when dry and 4 or 5 when moist. Texture is loamy fine sand, fine sand, or sand. Fine gravel content is 0 to 5 percent.

Treble series

The Treble series consists of very deep, well drained soils on foot slopes, foothills and mountainsides. These soils formed in glacial till derived dominantly from granite, gneiss, and schist. They have a thin mantle of moss and volcanic ash. Slope is 5 to 65 percent. Elevation is 2,200 to 4,000 feet. Average annual precipitation is 25 to 38 inches, and average annual air temperature is 42 to 46 degrees F.

These soils are loamy-skeletal, mixed, frigid Dystric Ochrepts.

Typical pedon of a Treble gravelly sandy loam in an area of Treble-Rock outcrop association, 20 to 65 percent slopes, about 0.75 mile northeast of Clagstone; about 1,900 feet west and 800 feet north of the northeast corner of sec. 14, T. 54 N., R. 4 W.

0.75 to 0.25 inch; needles, leaves, and twigs.

0.25 inch to 0; decomposed organic matter.

0 to 2 inches; dark grayish brown (10YR 4/2)

gravelly sandy loam, very dark gray (10YR 3/1)

moist; moderate fine granular structure; soft, very

friable, slightly plastic; many very fine roots and

common fine and medium roots; many very fine and

fine and common medium tubular pores; 25 percent

gravel; slightly acid (pH 6.2); clear wavy boundary.

2 to 7 inches; yellowish brown (10YR 5/4) gravelly

sandy loam, dark yellowish brown (10YR 3/4) moist;

weak fine and medium subangular blocky structure parting to moderate fine granular; soft, friable, slightly plastic; many very fine, common fine, and few medium roots; many very fine, common fine, and few medium tubular pores; 30 percent gravel; slightly acid (pH 6.2); gradual wavy boundary.

B22—7 to 18 inches; light yellowish brown (10YR 6/4) very gravelly coarse sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium and coarse subangular blocky structure parting to moderate fine granular; soft, friable, slightly plastic; many very fine roots, common fine and medium roots, and few coarse roots; many very fine, common fine, and few medium tubular pores; 40 percent gravel; medium acid (pH 6.0); clear wavy boundary.

B23—18 to 27 inches; light yellowish brown (10YR 6/4) very gravelly coarse sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable; common very fine and few fine roots; many very fine and few fine tubular pores; 45 percent gravel and 10 percent cobbles; medium acid (pH 6.0); clear wavy boundary.

IIC1—27 to 36 inches; variegated very gravelly loamy coarse sand; single grain; loose; few very fine and fine roots; many very fine interstitial pores; 40 percent gravel and 5 percent cobbles; medium acid (pH 6.0); gradual wavy boundary.

IIC2—36 to 60 inches; variegated very gravelly loamy coarse sand; single grain; loose; few very fine and fine roots; many very fine interstitial pores; 45 percent gravel, 10 percent stones, and 5 percent cobbles; medium acid (pH 6.0).

The solum is 24 to 34 inches thick. The profile is medium acid to neutral.

A1 horizon: Value is 4 or 5 when dry and 2 or 3 when moist, and chroma is 1 to 3 when moist or dry. Rock fragment content is 15 to 25 percent.

B2 horizon: Chroma is 3 or 4 when moist or dry. Rock fragment content is 25 to 55 percent. In some pedons this horizon has a few clay bridges or clay bands in the lower part.

IIC horizon: Texture is very gravelly, extremely gravelly, very cobbly, or very stony loamy coarse sand, coarse sandy loam, or sandy loam. Rock fragment content is 40 to 80 percent. In some pedons this horizon has a few clay bridges or clay bands in the upper part.

Vassar series

The Vassar series consists of deep and very deep, well drained soils on mountains. These soils formed in material derived from granite, gneiss, and schist and have a thick mantle of volcanic ash. Slope is 30 to 65

percent. Elevation is 2,600 to 4,000 feet. Average annual precipitation is 30 to 40 inches, and average annual air temperature is 41 to 43 degrees F.

These soils are medial over loamy, mixed Entic Cryandepts.

Typical pedon of Vassar silt loam, 30 to 65 percent slopes, about 3 miles northwest of the town of Spirit Lake; about 300 feet north and 1,700 feet east of the southwest corner of sec. 35, T. 54 N., R. 5 W.

O1—2 inches to 1 inch; needles, leaves, twigs, and moss.

O2—1 inch to 0; decomposed organic matter.

A1—0 to 1 inch; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; soft, very friable, slightly plastic; many very fine and fine roots, common medium roots, and few coarse roots; many very fine tubular pores; neutral (pH 7.0); abrupt wavy boundary.

B21ir—1 inch to 7 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable, slightly plastic; many very fine and fine roots, common medium roots, and few coarse roots; many very fine tubular pores; neutral (pH 6.8); gradual wavy boundary.

B22ir—7 to 21 inches; light yellowish brown (10YR 6/4) silt loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable, slightly plastic; common very fine and fine roots and few medium and coarse roots; common very fine tubular pores; slightly acid (pH 6.4); abrupt wavy boundary.

IIB31t—21 to 39 inches; very pale brown (10YR 7/4) gravelly sandy loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly plastic; common very fine and fine roots and few medium and coarse roots; common very fine and fine tubular pores; few thin clay films lining pores; 15 percent gravel and 10 percent cobbles; slightly acid (pH 6.4); clear wavy boundary.

IIB32t—39 to 50 inches; very pale brown (10YR 8/3) cobbly sandy loam, light yellowish brown (10YR 6/4) moist; weak coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine and medium roots; common very fine and fine tubular pores; few thin clay films lining pores; 15 percent gravel and 15 percent cobbles; medium acid (pH 6.0); clear wavy boundary.

IICr—50 inches; weathered schist

Bedrock is at a depth of 40 inches to more than 60 inches. The profile is medium acid to neutral. Some pedons have a layer of light gray volcanic ash 0.5 inch thick or less on the surface.

A1 horizon: Value is 4 or 5 when dry and 2 or 3 when moist, and chroma is 2 or 3 when dry or moist. Fine gravel content is 0 to 5 percent.

B2ir horizon: Hue is 10YR or 7.5YR, and chroma is 3 or 4 when dry and 3 to 6 when moist. Texture is silt loam or very fine sandy loam. Gravel content is 0 to 15 percent.

IIB3t horizon: Hue is 10YR or 7.5YR, value is 6 to 8 when dry and 4 to 6 when moist, and chroma is 3 or 4 when dry or moist. Rock fragment content is 15 to 35 percent.

Vay series #60

The Vay series consists of deep and very deep, well drained soils on mountains. These soils formed in material derived from granite, gneiss, and schist and have a thick mantle of volcanic ash. Slope is 20 to 65 percent. Elevation is 3,200 to 5,600 feet. Average annual precipitation is 35 to 50 inches, and average annual air temperature is 40 to 43 degrees F.

These soils are medial over loamy-skeletal, mixed Entic Cryandepts.

Typical pedon of Vay silt loam in an area of Vay-Ardtoo association, 35 to 65 percent slopes (fig. 18); about 2 miles southeast of Vay; about 2,300 feet west and 2,100 feet south of the northeast corner of sec. 20, T. 55 N., R. 3 W.

O1—2 inches to 1 inch; needles, leaves, and twigs.

O2—1 inch to 0; decomposed organic matter.

A1—0 to 6 inches; yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 3/4) moist; moderate medium subangular blocky structure parting to strong fine granular; soft, very friable, slightly plastic; many very fine and fine roots and common medium and coarse roots; many very fine and common fine tubular pores; medium acid (pH 6.0); clear wavy boundary.

B21ir—6 to 16 inches; light yellowish brown (10YR 6/4) gravelly silt loam, dark yellowish brown (10YR 4/4) moist; moderate medium and coarse subangular blocky structure; soft, very friable, slightly plastic; many very fine and fine roots and common medium and coarse roots; many very fine and common fine tubular pores; 20 percent gravel; medium acid (pH 6.0); abrupt wavy boundary.

IIB22—16 to 25 inches; pale brown (10YR 6/3) very gravelly loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly plastic; common very fine roots and few fine, medium, and coarse roots; many very fine and common fine tubular pores; 40 percent gravel; medium acid (pH 6.0); clear wavy boundary.

IIB3t—25 to 42 inches; very pale brown (10YR 8/3) extremely gravelly coarse sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; few

Continued →
Next Pg.



Figure 18.—Profile of Vay silt loam. The upper 16 inches is mainly volcanic ash.

very fine and fine roots; many very fine, common fine, and few medium tubular pores; 60 percent gravel and 5 percent cobbles; two clay bands 1.5 and 0.25 inch thick; slightly acid (pH 6.2); gradual wavy boundary.

IIIcR—42 inches; weathered granite.

Bedrock is at a depth of 40 inches to more than 60 inches. The profile is medium acid to neutral. Some pedons have a layer of light gray volcanic ash 0.5 inch thick or less on the surface.

A1 horizon: Chroma is 2 to 4 when dry or moist. Texture is silt loam or gravelly silt loam. Gravel content is 0 to 20 percent.

B2ir horizon: Hue is 10YR or 7.5YR, value is 5 to 7 when dry and 3 or 4 when moist, and chroma is 3 to 6 when dry or moist. Texture is silt loam, gravelly silt loam, or cobbly silt loam. Rock fragment content is 0 to 30 percent.

BIB2 horizon: Chroma is 3 or 4 when dry or moist. Texture is very gravelly or very cobbly loam or sandy loam. Rock fragment content is 35 to 60 percent.

BIB3t horizon: Hue is 10YR, 7.5YR, or 2.5Y, value is 6 to 8 when dry and 4 to 6 when moist, and chroma is 3 or 4 when dry or moist. Texture commonly is extremely gravelly, very cobbly, or very stony coarse sandy loam. In some pedons texture is very gravelly or very cobbly loamy coarse sand in the lower part. Rock fragment content is 40 to 80 percent.

END VAY

Wrenco series

The Wrenco series consists of very deep, very poorly drained soils on low stream terraces, flood plains, and bottom lands. These soils formed in lake-laid sediment derived from mixed sources. Slope is 0 to 2 percent. Elevation is 2,050 to 2,100 feet. Average annual precipitation is 30 to 35 inches, and average annual air temperature is 42 to 45 degrees F.

These soils are fine, mixed, frigid Typic Haplaquolls.

Typical pedon of Wrenco silty clay, 0 to 2 percent slopes, about 0.3 mile north of Seneacquoten, near the Pend Oreille River; about 1,600 feet east and 1,900 feet north of the southwest corner of sec. 31, T. 56 N., R. 3 W.

O1—0.5 inch to 0; grass, roots, stems, and leaves.

A11—0 to 5 inches; mixed gray (10YR 5/1) and grayish brown (10YR 5/2) silty clay, very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) moist; strong fine and medium subangular blocky structure parting to strong fine and medium granular; hard, firm, sticky and very plastic; many very fine, common fine, and few medium roots; common very fine and few fine and medium tubular pores; slightly acid (pH 6.2); clear wavy boundary.

A12—5 to 10 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; few fine distinct mottles that are dark yellowish brown (10YR 4/4) when moist; moderate medium and coarse subangular blocky structure; hard, firm, sticky and very plastic; common very fine roots and few fine and medium roots; common very fine and few fine tubular pores; common fine and medium iron and manganese stains; slightly acid (pH 6.2); gradual wavy boundary.

B21g—10 to 15 inches; mixed gray (10YR 6/1) and light brownish gray (10YR 6/2) silty clay, dark gray and dark grayish brown (10YR 4/1, 4/2) moist; common medium distinct mottles that are dark yellowish brown (10YR 4/4) when moist; moderate coarse subangular blocky structure; hard, firm, sticky and very plastic; few very fine, fine, and medium roots; many very fine and few fine tubular pores; common fine and medium iron and manganese stains; slightly acid (pH 6.2); clear wavy boundary.