

# THE CRYSTAL LAKE “WALKABOUT”

(Environmental Awareness Through “*Hands-On*” Education)

## INTERPRETIVE MANUAL

(Abridged Version)

An Educational Primer for Students;

A Reference Handbook for Property Owners and Visitors

Crystal Lake, Benzie County, Michigan

October 08, 2015, 23<sup>rd</sup> Edition

Dr. Stacy Leroy Daniels, “*Walkabout*” Creator  
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## **Dedication and Acknowledgements.**

***"Si Quaeris Lacam Effundam Circumspice." -- "If you seek a pleasant watershed, look about you."***

The Lake Michigan coastline of Northwest Lower Michigan captivated the imagination of all who "paddled by it" or "walked about it" - beginning with explorations by Frs. Marquette and Charlevoix; land surveys by Alvin and Austin Burt; geological surveys by Douglass Houghton, Henry Schoolcraft, and Alexander Winchell; the "**Tragedy**" / "**Comedy**" of Crystal Lake by Archibald Jones; geological studies by Henry Chandler Cowles, William James Beal, Warren Gookin Waterman, Irving D. Scott, Frank Leverett, Frank Taylor, James Lewis Calver, and Oren B. Evans; and prose by William L., Walter B., and Leonard L. Case, Bruce Catton, and Ernest Hemingway, continuing to the present. Thoreau walked Lake Michigan near Crystal Lake and "botanized" at the Carp River viewing the Manitou, Fox, and Beaver Islands.

The Crystal Lake Watershed contains a myriad of diverse, hydrologically intertwined ecologies and unique environmental niches: sand dunes, forested heights, wetlands, tributaries, and a large deep inland lake connected to Lake Michigan. It encompasses Crystal Lake, an immense body of pristine water of exceptional clarity, with a mixed sandy and rocky nearshore, a sandy shoreline, a deep marl bottom, and a high-ridged viewshed. It is the responsibility of those of us in the present to respect, maintain, and preserve the integrity of our Watershed for the generations that follow us. This Interpretive Manual for the Crystal Lake "**Walkabout**" is hereby dedicated toward that goal. It is hoped that it provides both interpretation and guidance for responsible stewardship by students, visitors, and property owners.

Cosponsors of the "**Walkabout**" have included: Crystal Lake & Watershed Association (**CLWA**) (prime sponsor); Crystal Lake Watershed Fund (founder); Grand Traverse Regional Land Conservancy; Grand Traverse Band of Ottawa and Chippewa Indians; Crystallake Camp; The Nature Conservancy; Friends of the Betsie Valley Trail; Friends of Betsie Bay; Friends of Point Betsie Lighthouse; U.S. Coast Guard – Station Frankfort; Congregational Summer Assembly; Benzie Conservation District; MSUE Michigan Groundwater Stewardship Program; Inland Seas Education Association; Tip of the Mitt Watershed Council; the Watershed Center - Grand Traverse Bay; Michigan Land Use Institute; Sleeping Bear Dunes National Lakeshore (NPS); Benzie Area Historical Society; Benzie-Leelanau District Health Department; Mills Community House Association; WasteWater Education; Betsie Lake Utilities Authority; and Northwest Michigan Invasive Species Network.

Thanks are given to several local and state foundations and civic organizations for their financial support. Special thanks to the Site Interpreters (120+ to date). Especial thanks are due to the dedicated teachers from Benzie Central Schools and Frankfort-Elberta Area Schools, who include the concepts of watershed interpretation and management into their curriculums; provide moral support, chaperons, and bus transportation, and especially, the student participants. Most sincere thanks to all of the students, who by their participation, make the "**Walkabout**" worthwhile for all of us.

Many other individuals and organizations have contributed interpretive sites, informational materials, publicity, and other services and facilities. These include: Bayside Printing, Inc.; Field Crafts, Inc.; Michigan Lake and Stream Associations; North American Lake Management Society; Water Environment Federation; The Benzie County Record Patriot; Michigan Sea Grant; Michigan Department of Environmental Quality; Michigan Department of Natural Resources; U.S. Geological Survey; U.S. Environmental Protection Agency; and local city, village, and township governments within the Crystal Lake Watershed.

2015 marks the 23<sup>rd</sup> year of the "**Walkabout**" conceived in 1993 and offered to ~ 5,500 participants. Interpretive Sites (now totalling 15) include GIS coordinates and Google map links. The Betsie River / Crystal Lake Watershed Management Plan is almost completed. Automatic monitoring of lake level has proven very useful. "The Comedy" of Crystal Lake", a new book, is noted [www.crystallakecomedy.com](http://www.crystallakecomedy.com) The 2015 Interpretive Manual will be posted at [www.CLWA.us](http://www.CLWA.us) We encourage its use by others with common interests in promoting watershed educational programs. Comments are welcome. You are cordially invited to participate/observe/interpret in the Crystal Lake "**Walkabout**"!

CLWA 231/882-4001, [info@CLWA.us](mailto:info@CLWA.us)

-- Dr. Stacy L. Daniels, Crystal Lake, October 08, 2015.

## Tab 1 Table of Contents.

Both the Abridged (16pp) and Unabridged Versions (58pp) of the 2015 Interpretive Manual describe these same 15 Interpretive Sites within 17 topical areas.

## Tab 2 What to Expect of the “Walkabout”

The concept of the **“Walkabout”** is borrowed from the Australian Aborigines who would take brief leave from daily living, *“walk about”* their environment, and renew their fundamental spiritual associations. The Crystal Lake **“Walkabout”** is intended to instill and nurture in young people and adults a sense of awareness of their watershed environment through an interactive program of science education involving “hands-on” observational monitoring and environmental exploring.

The **“Walkabout”** is more than just a single experience. While specific to the Crystal Lake Watershed, it has borrowed ideas from other programs, and can be extended to other watersheds. The **“Walkabout”** was originally designed for students, but its philosophy also applies to property owners and visitors. It can be practiced in a group, or by an individual.

## Tab 17 The Philosophy of “Walkabout” (All Sites).

The Crystal Lake Watershed contains diverse, hydrologically intertwined ecologies and unique environmental niches: active sand dunes, forested heights, wetlands, tributaries, and a large deep inland lake connected to Lake Michigan. It encompasses an immense body of pristine water of exceptional clarity, a mixed sandy and rocky nearshore, a sandy shoreline, a deep marl bottom, and a high-ridged vista. It is the responsibility of those of us in the present to respect, maintain, and preserve the integrity of our Watershed for the generations that follow us. The extended glacial history of the Crystal Lake Watershed coupled with its incredible diversity of ecological and environmental niches, is ideal for both recreation and education.

The **Crystal Lake “Walkabout”** is designed to educate students, property owners, and visitors about the Crystal Lake Watershed using a *“hands-on”* approach of observational monitoring and environmental exploring. Participants *“walk about”* a series of Interpretive Sites that represent differing environmental niches within the Watershed. At each Interpretive Site, *“Site Interpreters”*, who are knowledgeable individuals and/or environmental professionals, interact with the participants and conduct group activities.

A common theme linking the Interpretive Sites has been: *“How does a single drop of water enter, linger, and then pass through the Watershed?”* While the program focuses on hydrology, it also addresses water quality, ecology, land use, zoning, wells and septic tanks, green belts, sustainable development, and watershed management. The unique qualities of life as experienced by students, property owners, and visitors are related to physical features, environmental issues, public concerns, and educational aspects of the Watershed.

The **“Walkabout”** Interpretive Manual has evolved into *“An Educational Primer for Students”* and *“A Reference Handbook for Property Owners and Visitors”*. Its contents feature the Crystal Lake Watershed, but can be extrapolated to other watersheds. It is not a textbook, but introduces simple terms and concepts. It is revised as new Interpretive Sites are added and new concerns emerge. The **“Walkabout”** T-shirt has a colorful map of the Watershed on the front and logos of the cosponsors on the back. Please contact the **CLWA** if you enjoy working with young people and sharing your experiences. We are interested in learning of willing volunteers with sincere interests in environmental education.



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### **Tab 3 Map of the Crystal Lake Watershed.**

Crystal Lake is shaped like a big footprint - a large depression in the ground filled with lots of water. The outline of the high ridge around Crystal Lake is like an even bigger footprint with a big "toe". The Crystal Lake Watershed is tilted on the map ~20 degrees from NW to SE and contains the Lake and all of the land around it up to the tops of the high hills. Within the Crystal Lake Watershed are seventeen smaller "sub-watersheds", most with small creeks flowing into the Lake. Beyond the hills to the North is another larger watershed - the Platte River Watershed. To the South is yet another larger watershed - the Betsie River Watershed. To the West is a very large watershed - the Lake Michigan Watershed. The Crystal Lake Watershed is part of the Betsie River Watershed, which is part of the Lake Michigan Watershed.

A watershed is like splashing water in and out of a big "leaky" bathtub. Water falling from the air or flowing from the land washes into the lake (the tub). Water falling on the land or lake (the faucet) as rain and snow can go many directions: (1) flow downhill over the ground and directly into the Lake; (2) soak into the ground and slowly flow in several different directions; (3) be absorbed by plants; and (4) evaporate back into the air from the land and water surfaces. Some water that flows into the Lake flows out again through Outlet Creek (the drain). Other waters just soak into the ground and flow slowly away underground from the Lake into Lake Michigan or into the Platte or Betsie River Watersheds. Water can evaporate directly from the soil into the air or indirectly through the leaves of trees and other vegetation.

Another view of a watershed is to see how high the land rises above the lake surface on a topographic map of land contours. Looking closely at the map, you see "contour" lines for different land elevations. The closer the land contour lines are together, the steeper the slope (grade) of the land. The high ridges ("bluffs") rise almost 300 feet (~ 100 meters) above Crystal Lake. Crystal Lake is like a bathtub with very steep sides. During the "**Walkabout**" you may visit the high ridges at Railroad Point or Herdman's Bay.

Yet another view of a watershed is to look beneath the surface of a lake on a hydrographic (bathymetric) map of water contours. The closer the depth contour lines are together, the steeper the drop-off into deeper water. There is a long deep trench down the center of Crystal Lake where water depths exceed 150 feet (~ 50 meters). The maximum depth of Crystal Lake is about 165 feet; the mean depth is about 71 feet. The hills around Crystal Lake are unique among Michigan lakes. The highest hills (ridges) around Crystal Lake are about twice as high as the Lake is deep. During the "**Walkabout**" you may visit a Site on the shoreline of Crystal Lake at the East End (Beulah) or the West End (Frankfort).

The Crystal Lake Watershed is small compared to the two larger riverine (river) watersheds to the north and south. It contains parts of three townships around the Lake (Benzonia, Crystal Lake, and Lake); parts of three other townships (Homestead, Inland, and Weldon) are drained by Cold Creek. The Villages of Beulah and Benzonia are near the East End of Crystal Lake. The City of Frankfort and the Village of Elberta are near the West End of Crystal Lake (just over the hills), but are actually downstream in the Betsie River Watershed. Benzie County was first surveyed in 1838-9 by Alvin and Austin Burt, who called Crystal Lake, "Cap" Lake (short for "*Whitecap*", for its large foam-crested waves).

Geographical Information System (GIS) uses a computer to make maps to visualize the Watershed with layers of information put together like a deli sandwich. Each layer tells us something different: Watershed and sub-Watershed shapes; villages, roads, and other place names; lake depths and ridge heights; locations of tributaries and wetlands; critical slopes; vegetation cover; land use and zoning; environmental monitoring locations, "**Walkabout**" sites, etc. (Locations are in decimal degrees of north latitude and west longitude, resp. The "center" of Crystal Lake is found to be at 44.659167° N Latitude; -86.156389° W Longitude. As the crow flies, Crystal Lake is about halfway between "here" and "there". It is about halfway between the Equator and the North Pole (and about ¼ away around the world from the Prime Meridian). It is also halfway between the extreme northwestern edge of the Upper Peninsula (UP) and the extreme southeastern edge of the Lower Peninsula (LP) of Michigan.

## Tab 4 The Crystal Lake Watershed (All Sites).

### (4a) Watershed Facts.

There are myriad ways to view the Crystal Lake Watershed. A watershed: can be defined in two ways: (1) just the land around the Lake - the land that “sheds” runoff (rainwater and melted snow), or (2) both land and water. The total area (land plus water) making up the Crystal Lake Watershed is relatively small compared to other watersheds in MI. The Crystal Lake Watershed covers 43.67 sq mi (28,145 A) with a perimeter of 44.65 miles based on latest computer calculations. The surface area of Crystal Lake is 15.4 sq mi (9,854 A), making it the 9<sup>th</sup> largest inland Lake in Michigan! The Crystal Lake Watershed is unique in that the surface of the Lake is about 35% of the total Watershed (land + water).

Crystal Lake contains a lot of “crystal” clear water - almost a quarter of a trillion gallons (242,000,000,000 gallons = 740,000 Acre-ft = 0.22 cu mi)! If all the water in Crystal Lake was spread evenly over all of Benzie County (assuming that the land was flat and the water didn’t soak into the ground), it would cover the land to a depth of 3’-8”, or just about head-high for a five-year-old! It would take a faucet flowing at 10 gallons per minute for 51 years to reach the volume of water contained in 1 inch at the surface of Crystal Lake! Since its original discovery, Crystal Lake has become about 25% smaller in area and volume, and dramatically in level - now set by law at 600 feet above mean sea level (plus or minus ¼ foot, summer to winter). For more about the Crystal Lake Watershed, see at [www.CLWA.us/about\\_watershed.htm](http://www.CLWA.us/about_watershed.htm)

### (4b) Hydrologic Cycle.

Another unique feature of Crystal Lake is its 21-mile perimeter. This extended shoreline is due to a dramatic drop in the elevation (level) of the Lake during an “ill-fated” project to float logs back in 1873 known as the “**Tragedy**” of Crystal Lake. It was an unforeseen “**Comedy**” since a wide expanse of clean sandy beach was exposed where none existed before. The surface of Crystal Lake is still ~ 20 ft higher than Lake Michigan. A drop of water falling on the down slope of the high ridges will eventually flow into Crystal Lake, either as surface water (over the top of the ground) in tributaries such as Cold Creek, or as groundwater (underneath the ground) and emerge in Crystal Lake from underwater springs.

Water can also flow from Crystal lake into Lake Michigan either as surface water though Outlet Creek, or as groundwater beneath the surface, particularly at the West End of Crystal Lake toward Pt. Betsie. The level of Crystal Lake is controlled at the Outlet Creek at 600.25 ft in the summer (May 1 - Oct 31) to give more water for boating, and 599.75 ft in the winter (Nov 1 - Apr 30) to reduce shoreline erosion.

### (4c) Layers of Crystal Lake.

Our Lake can be viewed as pieces of a layered “cake” in constant motion. You can “slice” it horizontally into layers (profiles) or vertically into pieces (transects). It depends on whether you nibble at the edges or the top, or cut the frosting in the center down to the bottom. You can describe a cake by its taste and flavor, frosted, with fruit and nuts, hot from the oven or at room or refrigerator temperature. The layers of the Lake are described by its light penetration and by its water temperature. While we are most familiar with the shallow nearshore waters where we swim and play, we also fish and boat in the deeper waters.

Our Lake has distinct zones of biological communities linked to its physical structure, i.e. water depth, light penetration, and temperature. The littoral zone includes the nearshore water where sunlight penetrates all the way to the bottom allowing aquatic macrophytes (plants) to grow. While it includes the shallow waters, the littoral zone extends out from shore to the bottom of the euphotic zone where it is too dark for macrophytes to grow. The shoreline zone (where lake and land meet) is often defined as the lands 1,000 ft from the ordinary high-water level. For Crystal Lake, the surrounding land is not flat, but consists of high hills, and the shoreline zone is quite narrow around the Lake. The Crystal Lake Watershed Overlay District (CLWOD) is a jurisdictional area of land extending from the lakeshore a minimum of 500 feet, and in some places much further as it follows the topography and perimeter of the Watershed. Restrictive regulations are imposed within the CLWOD for zoning, development, vegetation removal, and septic system installation.

## Tab 5 “Walkabout” Sites (A - N).

The Crystal Lake Watershed with its myriad environments can be interpreted from myriad viewpoints. It contains a myriad of diverse, hydrologically intertwined ecologies and unique environmental niches: active sand dunes, forested heights, wetlands, tributaries, and a large deep inland lake connected to Lake Michigan. It encompasses Crystal Lake, an immense body of pristine water of exceptional clarity, with a mixed sandy and rocky nearshore, a sandy shoreline, a deep marl bottom, and a high-ridged vista. The Crystal Lake **“Walkabout”** addresses the diverse environmental features of a series of Interpretive Sites, each experienced in its own natural setting. The series of **“Walkabout”** Interpretive Sites continues to evolve from a progression of interests, concerns, and demands noted in each topic title.

### Cumulative List of Interpretive Sites

(Description / Location (N Lat, W Long, Elev) / Satellite View

#### Site A. Crystal Lake (Lake, East End).

Beulah Public Beach; 44.630124, -86.095630, 183m, 600 ft, <http://goo.gl/maps/zHqWm>

#### Site B. Cold Creek/Sediment Basin (Tributary).

Clark St., Beulah; 44.629403, -86.092952, 184 m, 603 ft, <http://goo.gl/maps/FrdY5>

#### Site C. Trapp Farm Nature Preserve (Lake Wetlands).

Narrow Gauge Rd.; 44.632310, -86.086939, 184 m, 603 ft, <http://goo.gl/maps/G8qqV>

#### Site D1. Crystal Lake Outlet (Discharge).

Mollineaux Rd., near Outlet Ck; 44.636222, -86.147203, 183 m, 600 ft, <http://goo.gl/maps/h1YYh>

#### Site D2. Railroad Point Natural Area (High Ridge).

Mollineaux Rd.; 44.637294, -86.139588, 213 m, 698 ft, <http://goo.gl/maps/xlCgu>

#### Site E1. Crystal Lake (Lake, West End).

CSA Beach; 44.665299, -86.245041, 183 m, 600 ft, <http://goo.gl/maps/2HrIL>

#### Site E2. Crystal Lake (Lake, West End).

Bellows Park; 44.660806, -86.232056, 183 m, 600 ft, <https://goo.gl/maps/waxTVNK5suC2>

#### Site F. Betsie Valley Trail (River Wetlands).

River Rd & M-22 Bridge; 44.619035, -86.221151, 176 m, 577 ft, <http://goo.gl/maps/RWKlj>

#### Site G. Betsie Bay (Bay / Great Lakes / USCG).

Coast Guard Station, Frankfort; 44.630025, -86.244139, 176 m, 577 ft, <http://goo.gl/maps/MJt2>

#### Site H. Pt. Betsie (Dunes / Lighthouse).

Pt. Betsie Rd. @ Lake Michigan; 44.690647, -86.255023, 176 m, 577 ft, <http://goo.gl/maps/M9rz6>

#### Site I. Benzie Area Historical Museum (Heritage)

6941 Traverse Ave., Benzonia; 44.617374, -86.100323, 251 m, 823 ft, <http://goo.gl/maps/ptIPR>

#### Site J. Round Lake (Bay of Crystal Lake).

M-22, entering SBDNL; 44.694187, -86.186623, 185 m, 606 ft <http://goo.gl/maps/h7Y4y>

#### Site K. Herdman’s Bay/Winnetka Point (High Ridge).

Herdman’s Bay Rd @ M-22; 44.686811, -86.191598, 249 m, 744 ft, <http://goo.gl/maps/tPbvP>

#### Site L. Betsie Lake Utilities Authority (Wastewater Treatment).

Spring St. @ M-22, Frankfort; 44.630407, -86.224051, 180 m, 592 ft, <http://goo.gl/maps/i2dyN>

#### Site M. Crystal Lake Boating Access Site (Fisheries).

Mollinaux Rd. (E) @ M-115; 44.636456, -86.127239, 183 m, 600 ft, <http://goo.gl/maps/bP62p>

#### Site N. Personal Choice.

(One’s own special place in your mind’s eye.)

For more on the philosophy, origin, evolution, and operation of the **“Walkabout”**, see **Tab 17**. The following overview shows how the Interpretive Sites interrelate about the Crystal Lake Watershed.

During the **“Walkabout”** you will visit several Interpretive Sites in the Crystal Lake Watershed and learn how they are related hydrologically with one another.

### **Site A. Crystal Lake (Lake, East End).**

Most of the surface water in the Crystal Lake Watershed is contained within Crystal Lake, the 9th largest inland lake in Michigan (in area). It is internationally famous for its "crystal clear" waters ( ~ 1/4-trillion gallons). The Crystal Lake Watershed is unique in that 35% of the total watershed is the surface of the Lake itself. The deepwaters, nearshore regions, tributaries, and outlet of Crystal Lake have been subjects of many comprehensive studies of water quality over the past century.

### **Site B. Cold Creek/Sediment Basin (Tributary).**

The major tributary (inflow stream) of Crystal Lake is Cold Creek. The North and Middle Branches are mostly within the Trapp Farm Nature Preserve (cf. Site C). This area was cedar swamp before the Lake was lowered in 1873. It has returned to its natural state and contains wetlands with abundant plant and animal life. The South Branch flows through mostly wooded terrain. All Branches of Cold Creek meet at the Sediment Basin (Holding Pond) near the Village of Beulah. (cf. Site K)

### **Site C. Trapp Farm Nature Preserve (Lake Wetlands).**

The Trapp Farm Nature Preserve was once a farm for abundant crops of celery, cabbage, broccoli, radishes, and onions. In 1991, the farm, containing regional significant wetlands, was donated to the Grand Traverse Regional Land Conservancy. The Preserve now encompasses 140 Acres. A number of trails have been developed for interpretive nature hikes through the diversity of ecosystems ranging from open fields to cedar stands, and including remnant orchards and mature woodlands.

### **Site D1 Crystal Lake Outlet (Discharge).**

The major outlet for surface water to discharge from Crystal Lake is located on the southeastern side of Crystal Lake. It is the site of the famous lowering of the Lake in 1873 by Archibald Jones and his Benzie County River Improvement Company, the "Tragedy" / "Comedy" of Crystal Lake.

### **Site D2 Railroad Point Natural Area (High Ridge) / Outlet (Discharge).**

Railroad Point is an undeveloped area (~ 200 Acres) features high-forested ridges ("bluffs") and a spectacular vista of Crystal Lake. A grant from the Michigan Natural Resources Trust Fund to the Grand Traverse Regional Land Conservancy conserved this resource. The Michigan Department of Natural Resources has constructed a boating access site nearby for fishermen and visitors. (See Site M)

### **Sites E1/E2. Crystal Lake (Lake, West End).**

Crystal Lake was originally a large bay (embayment) open to Lake Algonquin (prehistoric Lake Michigan). Over thousands of years, prevailing westerly winds created sand dunes closing it off from Lake Michigan. Crystal Lake is now ~ 23 feet higher in elevation than Lake Michigan. Water at the Lake's surface ("surface water") flows into Lake Michigan by way of Outlet Creek into the Betsie River, then into Betsie Bay at Frankfort and finally into Lake Michigan. Water beneath the ground ("groundwater") flows underground from Crystal Lake through the sand and into Lake Michigan near Pt. Betsie.

### **Site F. Betsie Valley Trail (River Wetlands).**

The Crystal Lake Watershed (a "lacustrine" or lake watershed) is part of the Betsie River Watershed (a "riverine" or river watershed). Crystal Lake overflows into the Betsie River by way of Outlet Creek. The Betsie Valley Trail, a 27-mile rail-trail, stretches between Thompsonville and Elberta/Frankfort, Michigan, and runs adjacent to Crystal Lake at Railroad Point, the Outlet, and Cold Creek. Geographic Information System (GIS) and Global Positioning System (GPS) technologies have been used extensively to highlight sites of special interest along the Trail, including the extensive wetlands near Betsie Bay.

### **Site G. Betsie Bay (Bay / Great Lakes / USCG).**

Betsie Bay (Lake) is located at the mouth of the Betsie River at Frankfort where it enters Lake Michigan. Its excellent harbor was used by car ferries to transport goods between Michigan and Wisconsin ports, and by commercial and sport fishermen. The Betsie River Watershed includes the Crystal Lake Watershed. Wastewaters from Frankfort and Elberta are collected in sanitary sewers and treated at the Betsie Lake Utilities Authority (BLUA) facility before discharge. The U.S. Coast Guard - Station Frankfort, near the mouth of the Bay, provides search and rescue services, and promotes boating and water safety.

### **Site H. Point Betsie (Dunes / Lighthouse).**

Pt. Betsie is the site of the world-famous Pt. Betsie Lighthouse, now under the stewardship of Benzie County and the Friends of Point Betsie Lighthouse. It is a prominent location mentioned in the early travels of Frs. Marquette and Charlevoix, and appears on many early maps. It is situated on the east shore of Lake Michigan with only a mile of sand dunes separating it from the Crystal Lake Watershed. The Point Betsie Dunes Preserve of ~ 94.5 Acres maintained by The Nature Conservancy - MI Chapter features interdunal wetlands, open dunes, cobble and sand beach, and pockets of boreal forest. Pitcher's thistle and Lake Huron locust are two species found only on Great Lakes shores. Spotted sandpiper and American redstarts are commonly seen there, as are migrating birds of prey, such as peregrine falcons.

### **Site I. Benzie Area Historical Museum (Heritage).**

The Benzie Area Historical Museum is owned and operated by the Benzie Area Historical Society that collects, interprets, and expands knowledge about Benzie area history. This educational facility is located in an historic 1887 church, which was the center of the religious colony that founded Benzonia in 1858. The exhibits are a cross-section of life in Benzie County from early inhabitants and pioneers to modern residents and tourists, describing aspects of exploration, lumbering, farming, fishing, and recreation.

### **Site J. Round Lake (Bay of Crystal Lake).**

Round Lake, a former bay of Crystal Lake, was left "high, but not dry" when the level of Crystal Lake was lowered in 1873. It is a small shallow lake (surface area ~ 15 Acres; avg. depth ~ 18 ft; max. depth ~48 ft). A small tributary flows through a marshy area into Herdman's Bay. About 2/3 of Round Lake lies within the Sleeping Bear Dunes National Lakeshore. Its ecological features include submergent and floating vegetation surrounded by forest and marsh in their original natural states. (cf. Cold Creek, Site B)

### **Site K. Herdman's Bay (Winnetka Point).**

Herdman's Bay, located along the north shore of Crystal Lake, is near Round Lake. It is named for Frank Herdman, an early settler from Winnetka, IL. The view of much of the Crystal Lake Watershed from the high ridge overlook is spectacular. (cf. Railroad Point, Site D).

### **Site L. Betsie Lake Utilities Authority. (Wastewater Treatment)**

Waters entering and leaving the Crystal Lake Watershed are included in an overall hydrological balance. Major inputs are precipitation (rain and snow); major outputs are surface and ground water flows, and evaporation. Wells provide drinking water and septic tanks providing wastewater treatment for individual homes. The Village of Beulah treats wastewater in lagoons before discharge to the Betsie River. The City of Frankfort treats wastewater at the Betsie Lake Utilities Authority before discharge to Betsie Bay.

### **Site M. Crystal Lake Boating Access Site. (Fisheries)**

The first State MDNR boating access site on Crystal Lake welcomed boaters and fishermen in 2012. The CLWA intends to operate a boating washing facility to deter the introduction of Aquatic Invasive Species.

Detailed descriptions for all Interpretive Sites are included within the unabridged Interpretive Manual.

Topics summarized in the following Tabs are related to one or more Interpretive Sites. (For details please see the unabridged Interpretive Manual available online at [www.CLWA.us](http://www.CLWA.us))

## **Tab 6 Environmental Quality (Site A, Sites E1/E2).**

Physical, chemical, and biological parameters of environmental quality are monitored to compare present conditions with baseline conditions. Recommendations for prevention and/or remediation are then considered in watershed management. The **CLWA** support monitoring of various parameters.

Multiparameter Analyzer (Hydrolab® Water Quality Multiprobes) are used to measure seven parameters at once in the Lake (depth, temperature, dissolved oxygen, pH, conductivity, redox potential, and/or turbidity). Values for each parameter at different locations are logged into a computer and evaluated.

Temperature of Crystal Lake is warm in Summer and cold in Winter. In the Spring, light, warm water (20°C = 68°F) at the surface forms a layer over heavy, cold water (6°C = 43°F) near the bottom. A thermocline (zone of sharp temperature change) forms between these layers at depths of 30-50 feet. All Lake water “turns over” and completely mixes twice as it warms in the Spring, and as it cools in the Fall.

Dissolved Oxygen (DO) in water is important to aquatic life. The DO of Crystal Lake may have 8-12 “ppm” (parts per million) of DO in summer, lower DO for a brief period in the fall, and 10-14 ppm in winter.

pH (Hydrogen Ion Concentration) is a measure of how much acidity or alkalinity is in water. A pH of 7 is neutral; a pH of 5 is 100 times more acidic; a pH of 9 is 100 times more alkaline. Some lakes like Crystal Lake (pH 8-9) are alkaline because of natural sediments of calcium carbonate (marl) that are very beneficial in controlling pH and phosphorus.

Conductivity is a measure of the dissolved salts (like table salt or road salt) in water. Water from Crystal Lake is like drinking water, and has much lower conductivity than seawater.

Redox Potential tells if Lake water can use more dissolved oxygen. Sediments that are anaerobic (little DO) have lower redox, are often black in color, and may have unpleasant odors. Sediments that are aerobic (lots of DO) have higher redox potential and no odors.

Turbidity (cloudiness) in water is due to suspended particles (washed from the shore, falling in rain, or precipitating in the Lake), plankton (microscopic plants & animals), and bubbles. In a very clear lake like Crystal Lake, turbidity and Total Suspended Solids (TSS) are very low.

Secchi Disk is a weighted circular disk painted in four black-and-white quadrants that is lowered into the water. Clarity of the water is determined as the depth at which the disk can no longer be seen. A deeper depth means clearer (less cloudy, less turbid) water. Secchi disc depths in Crystal Lake are 20-30 feet.

Phosphorus and Nitrogen are nutrients (fertilizers). A eutrophic (over-fertilized) lake has too much phosphorus, which can cause algae blooms that reduce dissolved oxygen and harm fish and other aquatic life. Phosphorus enters a watershed from “point” sources (septic tank discharges), or “nonpoint” sources (fertilizer runoff from the land, plant and animal debris, or airborne deposition). The excellent water quality of Crystal Lake is due to its oligotrophic (under-fertilized) condition.

Chemical Analyses include other elements: calcium and magnesium cause hardness (scale); sodium adds to conductivity; iron and manganese cause slight tastes; and arsenic, copper, chromium, lead, and zinc are toxic, but usually not detected in lake water at significant levels. Other analyses include: chlorophyll a, an indicator of algal growth; and specific organic compounds that may be present.

Biomonitoring is the assessment of plants and animals that may be affected by changes in physical and chemical parameters. Species include bacteria, algae, insects, snails, and mussels, fish, and humans.

Lake Level rises and falls when rain and melted snow enter, and falls when surface and ground waters leave. Level is also affected by winds and lake “tide” (seiches).

## **Tab 7 Environmental & Human Health (Site L).**

Consideration of environmental and human health insures safe drinking water, treatment of wastewater, and disposal of solid wastes. In many rural communities, drinking water is provided by individual wells, and most wastewater is treated by individual onsite septic systems. The Benzie-Leelanau District Health Department (BLDHD) is responsible for inspection and permitting for wells and septic systems, and testing of bathing beaches. Testing of drinking water quality is done by the State of Michigan.

Drinking waters for the Village of Beulah and Benzonia, and the City of Frankfort, are provided by central wells. Wastewater from the Village of Beulah is collected by sewers and piped out of the Crystal Lake Watershed to lagoons for treatment before discharge into the Betsie River. Wastewater from the City of Frankfort is collected and treated at the Betsie Lake Utilities Authority (BLUA) wastewater treatment plant.

Coliform bacteria are found naturally in soil and water and are associated with living plants and animals. They are found in the digestive tract of warm-blooded animals where they help to digest food and are always found in human feces. Fecal coliform bacteria are not necessarily agents of disease themselves, but are used as indicators for the potential presence of other pathogenic (disease-causing) bacteria. Sources of coliform bacteria are birds and farm animals; failed septic systems; inadequate wastewater treatment; and combined sewer overflow and surface runoff, which may increase during heavy rains or snow melts. The presence of coliform bacteria in a water sample simply means that the water may have been in contact with fecal matter, and further tests are needed to determine if there is a potential risk to human health. E. coli is typically used as an indicator of possible water contamination.

### **Swimmer's Itch.**

Swimmer's itch (SI), or "cercarial dermatitis", is a skin irritation of humans after contact with surface water containing the SI parasite. It is a reoccurring problem in northern freshwater lakes, and worldwide in freshwater and marine settings. Cercariae, the infectious form of the parasite are released into water by snails that infect ducks. Duck feces released back into the water then completes the life cycle by infecting snails. Ducks and snails are not bothered, but humans become inadvertent targets. The cercariae penetrate human skin, and then die realizing the human is not a duck! The resulting irritation (red papules and itching) is a nuisance, but different from poison ivy, heat rashes, or insect bites.

There are two approaches to reduce the problem: (1) Break the life cycle in a lake by controlling the ducks and/or the snails. Some lake associations have tried duck control, but success is difficult because the major species, the common merganser (the saw-bill duck, the Benzie County namesake), is swift and wily, has large broods, and returns to the same lake year after year, and (2) Use caution when entering the lake and take preventive action upon leaving the lake. Chemical control of snails is ineffective in large lakes.

Exposure is increased by being in shallow waters in early morning during onshore winds. Application of topical creams and showering with vigorous rubbing after exposure are partial remedies. The **CLWA** has studied snail/duck populations and SI incidences, and assessed scarification of lake bottom to control snails and pyrotechnics to discourage merganser populations. In 2015, the CLWA, together with other lake associations, began a partnership with Oakland University researchers to investigate the ecotoxicology of the SI cercariae and the influence of temperature variations.

## **Tab 8 Tributaries (Cold Creek and Round Lake) (Site B, Site C, Site J).**

Sediment in water running off the surface of a watershed can reach a lake and degrade its water quality. Wetlands filling and vegetation clearing can increase sediment and nutrient loadings. Cold Creek, the major tributary to Crystal Lake includes the South Branch flowing through undeveloped woodlands, and the North and Middle Branches flowing through fallow farmlands. The Cold Creek Sediment Basin intercepts the combined flows and collects sediment from upstream runoff. The Trapp Farm Nature Preserve contains regionally significant wetlands. The CLWF completed a project, "Biomonitoring of the Cold Creek Watershed" in 2003 to survey benthic invertebrates and stream habitats.

## **Tab 9 Native, Nonindigenous, or Nuisance Species (Site A, Sites E1/E2, Site M).**

Exotic, invasive, alien, nonindigenous, and nuisance species are plants, animals, or microorganisms growing where they don't belong, or are not wanted, and competing with native species for food and space. They may have been intentionally introduced to improve fishing, to introduce new crops, or for ornamental landscaping, and later found to be of concern. Specific invasive species found within the Crystal Lake Watershed include: garlic mustard, purple loosestrife, spotted knapweed, Eurasian watermilfoil (EWM), Emerald Ash borer (EAB), and Zebra mussel (ZM). Although most undesirable invasive species are not found in the Crystal Lake Watershed prevention and control are important.

Native species include: lake trout, whitefish, and lake sturgeon. Some non-native species that are environmentally and/or commercially important: Atlantic smelt, rainbow & brown trout, and Coho & Chinook salmon. Other native species, like swimmer's itch, poison ivy, periwinkle (myrtle), baby's breath, and the common reed (*Phragmites*), can become nuisance species. Salmon and Atlantic smelt are nonindigenous to the Great Lakes, but have been in our lakes for decades, and are not exotic. The Atlantic smelt was planted in Crystal Lake in 1912, and later spread throughout all of the western Great lakes. The Lake Sturgeon is a "glacial relic" that has inhabited Crystal Lake since the last ice age.

The new MDNR Boating Access Facility on the south shore of Crystal Lake includes a five-lane launch with staging pier, boardwalk, ADA-accessible facilities, and ample parking. The Boat Washing Station operated by the CLWA serves to protect Crystal Lake from Aquatic Invasive Species (AIS).

## **Tab 10 Atmospheric and Sedimentary Effects (All Sites).**

Atmospheric chemistry (what reacts in the air and falls from the air) and sediment chemistry (what settles to the bottom of the lake and stays there) affect the Crystal Lake Watershed. Various air components include liquid droplets of rain and snow, fine particulate matter, volatile organic compounds, and ozone. Unlike rivers that are constantly flushed with cleaner waters, lakes act as sinks where pollutants may persist for long periods of time unless they are degraded or bound to sediments. A consequence is the imposition of a fish advisory for human consumption of certain fish because of their PCB content.

## **Tab 11 Lake Level (Crystal Lake Outlet) (Site D1).**

The level of Crystal Lake varies with the season, being high in early spring due to snowmelt and rain, and low in late fall due to evaporation. The winter and summer regulated levels should track the periodic natural cycles, which are affected by climate and fluctuate between "wet" "dry" years. The level of the Lake is controlled by adjusting the amount of water that is spilled over the Outlet Dam. A level of 600.25 ft (May 1 to Oct 31) provides for summer recreation; a level of 599.75 ft (Nov 1 to Apr 30) prevents water erosion. Lake levels now monitored every 15 min with a new gauge installed by CLWA.

## **Tab 12 Wetlands (Trapp Farm, Betsie Valley Trail (Site C, Site D1, Site F, Site J)).**

Wetlands are important ecologically, economically, and socially to the overall health of ecosystems. They provide habitats for plants and animals, and provide food, resting places, and seasonal habitats for migratory birds. Wetlands also provide desirable habitats for aquatic life, and prevent damage from erosion and flooding by controlling point and nonpoint source pollution. The riverine and lake wetlands are found in many variations, esp. at the Trapp Farm, the Betsie Valley Trail, Round Lake, and the Outlet.

## **Tab 13 Great Lakes (Site G).**

The Great Lakes, which contain 18 % of the surface water on Earth, are sensitive to effects of runoff of soils and farm chemicals, waste from cities, discharges from industrial areas and leachate from disposal sites. The Lakes are also vulnerable to direct atmospheric deposition of pollutants. The U.S. Coast Guard is responsible for search and rescue, law enforcement, and recreational boating safety.

#### **Tab 14 Dunes (Point Betsie) (Site H).**

Crystal Lake was once an embayment of Lake Algonquin, a glacial lake predecessor of Lake Michigan. Large moraines of sand and gravel were deposited around Crystal Lake as it was closed off from the big lake by a sandbar at Point Betsie. The sand dunes that were formed by prevailing winds are unique ecosystems containing the threatened Pitcher's thistle and piping plover, and the invasive baby's breath/ Conservation programs are supported by the Nature Conservancy and the Sleeping Bear Dunes National Lakeshore. Preservation of the Point Betsie Lighthouse, marking the southern entrance to the Manitou Passage, is provided by the Friends of Point Betsie Light.

#### **Tab 15 Benzie Area Heritage (Site I).**

Benzie County was exploited by logging; expanded by fruit growing; and developed as a tourist destination. The **"Tragedy"** / **"Comedy"** of Crystal Lake on 23 Aug 1873 involved lowering the level of the Lake and creating of 21-miles of sandy beach defining the Watershed. A new historical site marker at the Crystal Lake Outlet honors Archibald Jones and the Benzie County River Improvement Company. The effects of the "Tragedy" were felt well into the early 1900's. The transition into the "Comedy" is of recent interpretation and still continues. The former is forever indelibly inscribed in our collective memories; the latter only embellishes upon its virtues.

Within the Crystal Lake Watershed, we're all "Shedies" ("Lakie" + "Townie" + "Fudgie" = "Shedie" ). We may be permanent or summer residents within the Watershed – around the lakeshore, in the neighboring villages, or the surrounding countryside, - or we may be visitors. We all share a love for our Watershed, and wish to preserve it for future generations. As individuals and as families, we are all integral to a mutually supportive community where we impact each other in many ways for the betterment of our watershed environment. It indeed takes a watershed to raise our children and to mold them into responsible adults able to make informed decisions on watershed issues.

The Benzie Area Historical Society collects, interprets, and expands historical knowledge of the Benzie area. The Museum, located in an historic 1887 church building, once the center of the religious colony that founded Benzonia in 1858, contains a cross-section of Benzie County life from early inhabitants and pioneers to modern residents and tourists describing exploration, lumbering, farming, fishing, and recreation.

#### **Tab 16 Watershed Management (Sites B, C, D1, D2, F, H, K).**

The **CLWA** has taken a lead role in the development of a comprehensive Watershed Management Plan (WMP) for the "Betsie River / Crystal Lake Watershed. to be completed in 2015. It is coordinated by the Networks Northwest (formerly NWMCOG), with a lead role by the **CLWA**, in association with the Grand Traverse Regional Land Conservancy (GTRLC), and other stakeholders, including: the Benzie Conservation District; the Conservation Resource Alliance; the Benzie/Leelanau District Health Department; the Benzie Co. Drain Commission; the Benzie Co. Board of Commissioners; Benzonia, Crystal Lake, and Lake Townships, and other townships; the Green Lake/Betsie River Association, and the Sleeping Bear Dunes National Lakeshore (NPS). Others (E or H) to be determined by the WMP Steering Committee.

Interpretative Site N of the Crystal Lake **"Walkabout"** is left to the readers' choice. Perhaps almost unspoken for each of us is that special "place near the Lake" where we live, work, play, and think. Lake and Watershed properties might seem to be the prime responsibilities of government, institutions, or individual property owners. These properties, however, are also the responsibilities of visitors and summer renters to insure that they are used wisely and maintained appropriately. There are myriad ways that we may look at the Crystal Lake Watershed - as a student, a visitor, an owner of watershed property (a "lakie", a "townie", a "fudgie", etc.). All of us together ("*shedies*") have slightly different perspectives, but we all share the benefits - the use and enjoyment of our Watershed for fishing, boating, swimming, recreation, working, and living. We also share the same concerns for maintaining a proper balance between reasonable environmental protection and sustainable development. Together, we are all stewards of the environment that makes up Crystal Lake and its surrounding Watershed.



**CRYSTAL LAKE & WATERSHED ASSOCIATION**  
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October 08, 2015

To: Participants of the **Crystal Lake "Walkabout"**.

Welcome to the **Crystal Lake "Walkabout"**, an unique experience of observational monitoring and environmental exploring especially designed for young adults. Anyone who is young of heart and open of mind is welcome. Of all the inland lakes of Michigan, Crystal Lake is one of the most beautiful - to look at, swim in, fish in, boat on - everything you would ever want to do and enjoy at a lake, you can do at Crystal Lake. It is there for all of us to share now, but also to protect for the future.

The **"Walkabout"** will make you look at the Crystal Lake Watershed from myriad points of view. Sometime in the future you will be making informed choices on water quality, land use, zoning, wells and septic tanks, green belts, sustainable development, education, and watershed management.

The Interpretive Manual containing maps and facts depicting the Crystal Lake Watershed. During the **"Walkabout"**, you will be visiting three or four of fifteen geographically and environmentally different "Interpretive Sites", which will be interpreted by volunteer environmental professionals who will tell you how each Site relates to the Watershed.

You'll "learn about" and "talk about" our Watershed with a theme of "hydrology" - how water moves about our Watershed. You'll have chances to see and do things. Take notes and pictures. Your challenge is to learn about the myriad environments of the Crystal Lake Watershed: to help us all manage it wisely, and to keep its waters as clear and as beautiful for your children tomorrow as they are for you today. Enjoy the **Crystal Lake "Walkabout"** and learn about its unique Watershed.

Remember: act safely and respect the rights of others. Leave our Watershed as you found it. Observe, learn, and have fun!

Yours for the Crystal Lake Watershed,

2015 Fall Cosponsors:  
Crystal Lake & Watershed Association;  
Benzie Conservation District;  
USCG – Station Frankfort.

**Crystal Lake "Walkabout" – Thurs. Oct. 08, 2015; (Rainout Fri, Oct. 09, 2015).**

(Four concurrent ~45-min periods + ~15-min travel among Sites.)

Periods	Period I	Period II	Lunch	Period III	Period IV	Schools
Times	09:15	10:15	11:15	12:00	13:00	
1st Team	G --->	E2 --->	Park	D1 --->	M --->	FE
2nd Team	E2 --->	G --->	Park	M --->	D1 --->	BC
3rd Team	D1 --->	M --->	Park	G --->	E2 --->	BC
4th Team	M --->	D1 --->	Park	E2 --->	G --->	BC

Lunch: Mineral Springs Park (Frankfort); Restrooms At Park & City Hall

**"Walkabout" Interpretive Sites**

Date	Site	Description / Location (N Lat, W Long, Elev) / Satellite View
Fall 2015	E2.	<b>Crystal Lake (Lake, West End).</b> Bellows Park; <a href="https://goo.gl/maps/waxTVNK5suC2">44.660797, -86.232059, 183 m, 600 ft,</a> <a href="https://goo.gl/maps/waxTVNK5suC2">https://goo.gl/maps/waxTVNK5suC2</a>
Fall 2015	G.	<b>Betsie Bay (Bay / Great Lakes / USCG).</b> Coast Guard Station, Frankfort; <a href="http://goo.gl/maps/MIJT2">44.630025, -86.244139, 176 m, 577 ft,</a> <a href="http://goo.gl/maps/MIJT2">http://goo.gl/maps/MIJT2</a>
Fall 2015	D1.	<b>Crystal Lake Outlet (Discharge).</b> Mollineaux Rd., near Outlet Ck; <a href="http://goo.gl/maps/h1YYh">44.636222, -86.147203, 183 m, 600 ft,</a> <a href="http://goo.gl/maps/h1YYh">http://goo.gl/maps/h1YYh</a>
Fall 2015	M.	<b>Crystal Lake Boating Access Site (Fisheries).</b> Mollinaux Rd. (E) @ M-115; <a href="http://goo.gl/maps/bP62p">44.636456, -86.127239, 183 m, 600 ft,</a> <a href="http://goo.gl/maps/bP62p">http://goo.gl/maps/bP62p</a>

