# FINAL STUDY REPORT
# DEBRIS MANAGEMENT STUDY
# RSP 3.14

# CONOWINGO HYDROELECTRIC PROJECT

# FERC PROJECT NUMBER 405

***Prepared for:***

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## EXECUTIVE SUMMARY

Exelon Generation Company, LLC (Exelon) has initiated with the Federal Energy Regulatory Commission (FERC) the process of relicensing the 573-megawatt Conowingo Hydroelectric Project (Project). The current license for the Conowingo Project was issued on August 14, 1980 and expires on September 1, 2014. FERC issued the final study plan determination for the Conowingo Project on February 4, 2010, approving the revised study plan with certain modifications.

The final study plan determination required Exelon to conduct a Debris Management Study, which is the subject of this report. The purposes of this study are to: 1) analyze hydrologic conditions that initiate debris management actions; 2) review current debris management practices to ensure that they are consistent with best management practices; and 3) if not consistent with best management practices, assess need for additional practices to reduce impacts to Pond and downstream users.

An initial study report (ISR) was filed on February 22, 2011, containing Exelon's 2010 study findings. An initial study report meeting was held on March 9, 10 and 11, 2011 with resource agencies and interested members of the public. Formal comments on the ISR including requested study plan modifications were filed with FERC on April 27, 2011 by Commission Staff, several resource agencies and interested members of the public. Exelon filed responses to the ISR comments with FERC on May 27, 2011. On June 24, 2011, FERC issued a study plan modification determination order. The order specified what, if any, modifications to the ISRs should be made. For this study, FERC's June 24, 2011 order required no modifications to the original study plan. An updated study report (USR) was filed on January 23, 2012 addressing comments from stakeholders received at the March ISR meeting, those comments addressed by Exelon in the May 27, 2011 responses to ISR comments, as well as editorial and minor text changes. This final study report is being filed with the Final License Application for the Project.

At present, Exelon employs clamming (with three gantry cranes with grapple attachments) to remove submerged debris from the intakes as well as floating surficial debris in front of the dam. Debris management activities do not take place during high river flows due to safety concerns.

Debris trapped at Conowingo Dam does not always originate from the entire upstream Susquehanna River watershed of 27,100 square miles, due to the hydraulic capacities of the two upstream projects, Safe Harbor (110,000 cfs) and Holtwood (31,500 cfs). Debris trapped by the Conowingo Dam (hydraulic capacity of 86,000 cfs) at river flows below the Holtwood hydraulic capacity of 31,500 cfs likely originates almost entirely from the contributing watershed of 314 square miles between Holtwood and

Conowingo Dams. For flows between 31,500 cfs and 86,000 cfs, debris from the contributing drainage area of 1,010 square miles, between Safe Harbor and Conowingo Dams, would likely be captured at Conowingo Dam. At flows above 86,000 cfs, debris passes Conowingo Dam through the spill gates. Only at flows above the Safe Harbor hydraulic capacity of 110,000 cfs, would debris from the upper Susquehanna River would be mobilized into the system. Thus, the quantity of debris reaching the dam and available for removal can be very limited.

All debris removed is taken to Hopkins Cove where it is separated and sorted as organic, tires, plastic, trash, and metal. Organic debris (natural) is recycled and ground up into mulch. Artificial debris is sent to a disposal/recycling facility or landfill.

Exelon sponsors community-based clean-ups of Conowingo Pond and its tributaries upstream of the dam, and the Susquehanna River and tributaries downstream of the dam (Exelon Cleanup Day; Conowingo Creek cleanup; Lower Susquehanna Heritage Greenway River Sweep).

Debris management practices at the York Haven, Safe Harbor, and Holtwood Projects are similar to those employed at the Conowingo Project. These efforts focus on clearing trash racks that protect the intakes and generating units, and clearing the forebay to maintain unrestricted flow to turbine units.

Current debris management practices of the Conowingo Project are consistent with Best Management Practices and there is no need to institute additional practices.

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF APPENDICES

## LIST OF ABBREVIATIONS

Exelon – Exelon Generation Company, LLC

FERC – Federal Energy Regulatory Commission

ILP – Integrated Licensing Process

ISR- Initial Study Report

MW - Megawatt

NOI – Notice of Intent

PAD – Pre-Application Document

Project - Conowingo Hydroelectric Project

PSP – Proposed Study Plan

RSP – Revised Study Plan

SRBC – Susquehanna River Basin Commission

USGS – United States Geological Survey

USR- Updated Study Report

## 1.0 INTRODUCTION

Exelon Generation Company, LLC (Exelon) has initiated with the Federal Energy Regulatory Commission (FERC) the process of relicensing the 573-megawatt (MW) Conowingo Hydroelectric Project (Project). Exelon is applying for license renewal using the FERC's Integrated Licensing Process (ILP). The current license for the Conowingo Project was issued on August 14, 1980 and expires on September 1, 2014.

Exelon filed its Pre-Application Document (PAD) and Notice of Intent (NOI) with FERC on March 12, 2009. On June 11 and 12, 2009, a site visit and two scoping meetings were held at the Project for resource agencies and interested members of the public. Following these meetings, formal study requests were filed with FERC by several resource agencies. Many of these study requests were included in Exelon's Proposed Study Plan (PSP), which was filed on August 24, 2009. On September 22 and 23, 2009, Exelon held a meeting with resource agencies and interested members of the public to discuss the PSP.

Formal comments on the PSP were filed with FERC on November 22, 2009 by Commission staff and several resource agencies. Exelon filed a Revised Study Plan (RSP) for the Project on December 22, 2009. FERC issued the final study plan determination for the Project on February 4, 2010, approving the RSP with certain modifications.

The final study plan determination required Exelon to conduct a Debris Management Study, which is the subject of this report. The objectives of this study are to:

1. Analyze hydrologic conditions that initiate debris management actions;

2. Review current debris management practices to ensure that they are consistent with best management practices (BMPs); and

3. If not consistent with best management practices, assess need for additional practices to reduce impacts to Pond and downstream users.

An initial study report (ISR) was filed on February 22, 2011, containing Exelon's 2010 study findings. An initial study report meeting was held on March 9, 10 and 11, 2011 with resource agencies and interested members of the public. Formal comments on the ISR including requested study plan modifications were filed with FERC on April 27, 2011 by Commission Staff, several resource agencies and interested members of the public. Exelon filed responses to the ISR comments with FERC on May

27, 2011. On June 24, 2011, FERC issued a study plan modification determination order. The order specified what, if any, modifications to the ISRs should be made. For this study, FERC's June 24, 2011 order required no modifications to the original study plan. An updated study report (USR) was filed on January 23, 2012 addressing comments from stakeholders received at the March ISR meeting, those comments addressed by Exelon in the May 27, 2011 responses to ISR comments, as well as editorial and minor text changes. This final study report is being filed with the Final License Application for the Project.

## 2.0 BACKGROUND

The Susquehanna River Basin has a drainage area of 27,510 square miles with over 40,000 miles of streams in New York, Pennsylvania, and Maryland (SRBC 2004). Of this total drainage, nearly 27,100 square miles are located above the Conowingo Dam. Woodlands account for 70 percent of the total land cover of the basin, agricultural land makes up 22 percent, and urban developed land comprises seven percent (SRBC 2006).

Conowingo Dam is located at river mile (RM 10) of the Susquehanna River main stem. Three additional hydroelectric facilities are located upstream of Conowingo Dam - Holtwood Dam (RM 24), Safe Harbor Dam (RM 34) and York Haven Dam (RM 56). Some of the natural and human-generated debris moving through the Susquehanna River watershed gets trapped behind the hydroelectric facilities on the main stem in the lower Susquehanna River. Most debris is transported during high flow events, particularly during March and April.

Article 41 of the current FERC license for the Conowingo Project required the licensee, in consultation with the United States Army Corps of Engineers and Susquehanna River Basin Commission (SRBC), and in cooperation with the other three lower Susquehanna River hydro facilities, to conduct a study to determine the magnitude of river-borne debris and its management, the results of which would be filed with FERC within two years. This study[1] (cited in Brethauer 1985) was jointly prepared by the licensees of the four lower Susquehanna River hydro facilities and filed with FERC in August 1982. It reported an average of 75,000 cubic yards of debris is passed over or through each dam annually with the quantity of debris being nearly proportional to river flow.[2] This study also determined that 75 percent of the total estimated volume of material was discharged during high flow events (January through May) and concluded that debris management should be implemented as a basin-wide program.[3] Additionally, the report recommended that the most effective method to reduce debris affecting the lower Susquehanna River basin and Chesapeake Bay is at its source.[4]

[1] River-Bourne Debris Study Report (Susquehanna River Debris Electric Utilities Report (Safe Harbor Water Power Corporation, FERC Project No. 1025. FERC License Mandate Article #40. August 5, 1982.

[2] The value of 75,000 cubic yards as the average annual quantity of debris passing over or through each dam is cited by reference and the manner by which this number was calculated is not provided in the referenced source document. While it represents a quantity of debris reaching and passing the dams, it does not reflect the amount of debris being trapped by the dams.

[3] Letter (March 25, 1999) from PP&L, Inc. to FERC re Response to February 26, 1999 Request for Information from J. Mark Robinson on Management of River-Borne Debris

[4] Letter (March 24, 1999) from Susquehanna Power to FERC re Debris Management Plan

A 1989 cooperative agreement by the operators of the hydroelectric facilities, SRBC, and regulatory agencies led to routine debris removal actions during normal to low flows. However, during high flows debris may pass through dam gates, overtop spillways, and continue downstream. Local groups participate in annual clean-ups to remove debris in the watershed. In June 1999, at the Conowingo Project station, SRBC, Maryland State Department of the Environment, and FERC convened a public meeting to address management of floating debris in the Susquehanna River basin. It was noted that the Susquehanna River Basin is one of the most flood-prone basins in the country and that debris flow is flood-related and interstate in nature.

## 3.0 METHODS

The tasks outlined below identify the methods used to achieve the study objectives.

### 3.1 Review Existing Information

Existing data for this study was obtained from the following sources:

1. Current debris management practices implemented at the four hydroelectric facilities of the lower Susquehanna River were identified. To supplement information on Exelon's practices at Conowingo Dam, operators at each of the three hydroelectric facilities dams upstream of Conowingo Dam were contacted (letter dated August 5, 2010 – Appendix A) for information related to debris management practices they employ. Responses were received by November 16, 2010 (Appendix B).

2. Lower Susquehanna River watershed data relevant to debris management were researched. These included information pertaining to land cover, debris sources, and non-facility watershed clean-up efforts.

3. Hydrologic data from the USGS gage No. 01576000 (Susquehanna River at Marietta, PA) and USGS gage No. 01578310 (Susquehanna River at Conowingo, MD) provided information on the frequency and timing of high flow events.

### 3.2 Debris Management Assessment

Current facility debris management practices and watershed clean-up programs were evaluated to categorize volumes and types of debris. Photographs illustrate commonly observed debris conditions found in Conowingo Pond. Historic data were reviewed to identify trends in the type and quantity of debris, and relations, if any, with management techniques or river flow.

To identify any relation between hydrologic conditions and debris management activities at Conowingo Dam, hydrologic data of the Susquehanna River were compared with quantities of debris removal. This was accomplished by plotting quantities of debris collected at Conowingo Dam versus average monthly flows of the river measured at USGS gage No. 01576000 (Susquehanna River at Marietta, PA).

### 3.3 Identify and Evaluate Potential Improvements

The results of Task 1 and Task 2 were assessed to identify the need for improvements to the current management program at Conowingo Dam or watershed clean-up efforts within Conowingo Pond and its tributaries. Debris collection and removal management practices implemented at other similar facilities are provided.

## 4.0 RESULTS AND DISCUSSION

Debris is a term used to collectively refer to the remains of something broken down or destroyed. In Conowingo Pond, debris is found in a variety of forms, locations, and quantities. These are described below.

### 4.1 Debris Type and Occurrence

Debris can be natural or artificial (human-derived). In the Susquehanna River Basin, the vast majority of debris is natural in origin (SRBC 1999).

#### 4.1.1 Natural Debris

Natural debris primarily consists of streamside vegetation that falls directly into a water body or onto is its banks or floodplain. Floods or mass wasting on slopes may carry this material into the stream. Examples of natural debris include tree trunks and branches; brush and shrubs; leaves, grass clippings and dead animals. In Conowingo Pond natural debris is typically found as large woody debris accumulations (debris rafts or slugs) along the river shoreline or behind the dam; isolated logs within the river or stranded on exposed substrates during lower flows; and accumulations of woody debris behind and within tributary culverts. Figures 4.1.1-1 through 4.1.1-8 illustrate typical occurrences of natural debris in Conowingo Pond

Natural debris is organic and therefore biodegradable. However, some items such as large tree limbs or entire trees often take a long time to degrade and, as floating but partially submerged, are potential hazards to recreational boaters. Older trees that become waterlogged will be submerged below the water surface and minimally visible.

Natural debris also provides aquatic and semi-aquatic organisms with diverse habitat. Large secure debris provides good functional habitat while also protecting the shoreline from erosion. Secure debris can also trap sediment providing additional substrate for emergent wetlands. Figures 4.1.1-9 through 4.1.1-12 illustrate avian use of natural debris in the pond.

#### 4.1.2 Artificial Debris

Artificial debris, derived from human activities, compiles about 15 percent of the debris masses formed during high flows in the Susquehanna River basin (SRBC 1999). Examples of this type of debris include tires, metal and plastic 55-gallon drums, bottles and containers, shoreline structures, boats, lumber, appliances, furniture, garbage, etc. These items potentially may contain hazardous materials that can harm the aquatic community and recreational users of the river.

In Conowingo Pond, artificial debris is found mixed in amongst the natural debris slugs or as part of degraded shoreline structures. Figures 4.1.1-2, 4.1.1-6, 4.1.1-8, and 4.1.2-1 through 4.1.2-3 illustrate typical occurrences of artificial debris in the pond. Artificial debris has little habitat value and is visually unpleasant. It also can be harmful to fish and wildlife if eaten.

### 4.2 Debris Quantity

Conowingo Dam receives variable volumes of debris on an annual basis. Debris collected here has included wood sticks and logs, leaves, floating grass, tires, trash, plastic and glass bottles, propane tanks, oil tanks, docks, barrels, drums, floats, boats, pickup truck bed liners, sandboxes, and tarps. Most is trapped between the trash racks and head works. Some of the debris is more than 75 feet below the water level.

Table 4.2-1 provides quantities of debris collected and removed from the dam 1989 through 1998. Table 4.2-2 reports the amount of debris removed by either skimming (using boat skimmer) or clamming (clam shell in front of trash racks) from 2004 through September 2011. Between 1992 and 2008, Conowingo Dam utilized a self-propelled skimmer barge to capture floating debris. The skimmer barge was retired in 2008. In early 2011 Exelon added another crane with boom and grapple for removing debris. Thus, Exelon currently employs clamming by gantry cranes (three) with grapple attachments.

### 4.3 Debris Sources and Transport

As noted earlier, the largest quantities of debris are delivered to the lower Susquehanna River during high flow events from forested areas. Precipitation, storm runoff, and elevated stream flows dislodge upland, stream bank, and in-stream debris. Wind throw, decaying trees, and leaf drop from riparian areas adjacent to streams contribute to debris accumulation. High storm winds may also blow tarps, empty drums, and bed liners into the river. During low flows, debris may become stranded at higher elevations and pile up as flood flows recede or pool levels are lowered. In the fall, senescent aquatic vegetation can become dislodged and create a short-term in-stream source.

Stranded debris accumulates within tributary culverts or piles at the upstream side at wing walls in Conowingo Pond (Figures 4.1.1-5 through 4.1.1-8). Debris also impedes normal tributary inflow to Conowingo Pond by being deposited within the tributaries themselves (Figures 4.3-2 and 4.3-3). Not all debris that enters Conowingo Pond is transported to the dam; debris may be stranded on shallows as water elevations recede; or become waterlogged and lodged in place within bottom sediment, if large enough, or become too heavy to be carried all the way downstream to the dam before impinging the shoreline. This material may not be carried to the dam until the next large flow event.

To evaluate if a relationship between high river flow and quantity of debris could be discerned, annual debris collection quantities at Conowingo Dam were plotted against average monthly flows measured at the Marietta gage[5]. Figure 4.3-1 displays the lack of an obvious trend from the limited data available. A data gap between 1998 and 2006 exists for quantity of debris collected. Available debris removal data are recorded as annual totals and therefore cannot be correlated with monthly river flow. However, it is still possible that a large-scale megascopic relation between annual removal quantities and river flow would be evident in the data, if present. A review of the data finds this is not the case due to the combination of the following circumstances summarized in Table 4.3-1. Safe Harbor, Holtwood, and Conowingo each have different hydraulic capacities. Thus, at different river flows, the factors determining the quantity of debris trapped at Conowingo Dam are: 1) river flow in relation to the project hydraulic capacity of each facility and 2) contributing drainage area.

York Haven is a run-of-river facility; debris reaching the dam from the upstream watershed passes over the facility or is sluiced downstream (see Section 4.4.2.1). Safe Harbor is a peaking facility with a maximum turbine hydraulic capacity of 110,000 cfs.[6] Debris passes Safe Harbor when flows exceed its hydraulic capacity. Thus, until a river flow of 110,000 cfs is exceeded, the debris passing York Haven is trapped at Safe Harbor.

Holtwood is also a peaking facility with an approximate hydraulic capacity of 31,500 cfs (PPL Holtwood 2007). Thus, for debris originating from the watershed upstream of Holtwood Dam to reach Conowingo Dam, river flows must exceed 31,500 cfs. As indicated in Table 4.3-1, until Safe Harbor's hydraulic capacity of 110,000 cfs is exceeded, the material trapped at Holtwood is from the watershed of its reservoir, Lake Aldred.

The Conowingo Dam utilizes limited active storage in combination with the operation of the Muddy Run Pumped Storage Project to meet peak electrical demand. The maximum hydraulic capacity of the Conowingo powerhouse is 86,000 cfs (Exelon 2009). When this flow is exceeded water and debris are carried through dam gates, over the dam spillway and downstream. When river flows are below 31,500 cfs, the debris reaching and trapped at Conowingo comes from the Conowingo Pond watershed. When river flow exceeds the Holtwood hydraulic capacity (31,500 cfs), yet remains below Conowingo's hydraulic capacity (86,000 cfs), debris from both the Lake Aldred and Conowingo Pond watersheds will be trapped at Conowingo. This same material will pass Conowingo only when 86,000 cfs is exceeded.

[5] http://nwis.waterdata.usgs.gov/nwis
[6] Safe Harbor Water Power Corporation website. http://www.shwpc.com/facts_figures.html.

Debris from the entire lower Susquehanna River watershed does not reach Conowingo until it can pass Safe Harbor, at flows over 110,000 cfs. At 110,000 cfs Conowingo Project will have at least two crest gates open; most debris passes through both the Safe Harbor and Conowingo crest gates. Debris is never intentionally diverted over the spillway at Conowingo but passes only when flows exceed the Project hydraulic capacity and crest gates are opened.

The quantity of debris reaching Conowingo Dam is a combined function of the varied hydraulic capacities of upstream facilities and changing contributing watershed areas. It is therefore not surprising there is no obvious relationship between river flow and quantity of debris removal at Conowingo Dam. Additionally, the trapping of debris at the mouths of tributaries to Conowingo Pond reduces the quantity of material actually reaching Conowingo Dam from the pond watershed. This further skews the already non-direct relationship between river flow and debris removal at Conowingo Dam**.** And, debris remaining within Conowingo Pond between large flow events by stranding or lodging are related to storm flows that preceded the one that carried it to the dam.

Ultimately, when compared to the quantity of debris generated in the entire lower Susquehanna River watershed, relatively little debris reaches Conowingo Dam due to the trapping of debris at Safe Harbor and tributary mouths. The daily mean discharges measured at Conowingo were reviewed (January 1, 1968 through December 31, 2010). On average, Project capacity was exceeded 35 days per year during this period. In 2004 stream flows exceeded Project capacity a total of 77 days. When debris is trapped at Conowingo during the remainder of the year, the contributing watershed is either 314 square miles or 1,010 square miles, in contrast to the 27,100 square miles of total drainage upstream of Conowingo Dam (Table 4.3-1). This limits the quantity of debris available for removal at Conowingo which is reflected in the actual debris removal quantities provided in Tables 4.2-2 and 4.4.2.2-1 from Conowingo and Safe Harbor, respectively, for the same time period. Much less is removed at Conowingo because much less reaches Conowingo.

## 4.4 Debris Management Efforts

### 4.4.1 Conowingo Pond and Below the Dam

Exelon estimates approximately 75 percent of the debris removed at Conowingo Dam is natural and the remaining 25 percent is artificial. At present, Exelon employs clamming (with three gantry cranes with grapple attachments) to remove submerged debris from the area upstream of the powerhouse intakes as well as floating surficial debris in front of the powerhouse intakes (Figure 4.4.1-1). Debris management activities do not take place during high river flows due to safety concerns.

Exelon does not remove debris before it reaches the upriver side of the dam. Exelon does, however, sponsor community-based clean-ups in the pond and downstream of the dam.

- The first annual Exelon Cleanup Day on June 11, 2011 collected nine 30-cubic yard dumpsters of debris and five drums of chemicals from Hopkins Cove, Glen Cove, Broad Creek boat launch, Line Bridge Road launch, and Dorsey Park. Trash, tires, sunken boats, lawn furniture, and bottles were hauled off-site by a commercial waste disposal company.

- An April 2011 clean-up of the Conowingo Creek launch collected one 30-cubic yard dumpster of debris hauled off-site by a commercial waste disposal company.

- The Lower Susquehanna Heritage Greenway River Sweep on April 23, 2011, an annual event co-sponsored by Exelon, removed 24-tons of debris (tires, propane tanks, glass, toys, and textiles)[7] downstream of the dam at Port Deposit, Havre de Grace, and Exelon's Octoraro Creek Trail.

### 4.4.2 Upstream Hydroelectric Facilities

The following information was provided to Exelon by York Haven Power Corporation (YHPC), Safe Harbor Water Power Corporation (SHWPC), and PPL Holtwood LLC (Appendix B).

#### 4.4.2.1 York Haven Dam

The York Haven facility has a limited ability to collect and remove debris. The project's hydraulic capacity is 16,000 cfs. When the flow is exceeded most of the debris is spilled over the project's two dams. This condition occurs more than 60 percent of the time.

Debris management at York Haven focuses on clearing the trash racks that protect the intakes and generating units, and clearing the forebay to maintain unrestricted flow to the units. Rack cleaning is performed by a trash rake which guides debris to a sluice gate which is opened to return trash rack and forebay debris to the river. An effort is made to remove artificial debris in the forebay prior to opening the sluice. Chainsaws attached to long, stout poles are used to cut up logs.

In addition, York Haven routinely collects and disposes of debris at recreation areas and uses boats and divers to collect trash. It is estimated that approximately 25 cubic yards of debris per year is removed in this manner

[7] Theresa G. Wiseman (Lower Susquehanna Heritage Greenway). Rain-Soaked River Sweep. *Enviro News: A newsletter for environmental programs in Harford County*. Fall 2011. p.3

#### 4.4.2.2 Safe Harbor Dam

Debris is removed at Safe Harbor Dam with a clam shell at the skimmer wall and unit intakes, and a trash rake on intake screens. The types of debris removed at Safe Harbor include natural tree wood, tree foliage, grasses, trash (e.g., bottles appliances, LP gas tanks, tires and rims, plastic 55-gallon drums) and dead animals (e.g., deer, pigs, fish, turtles, birds, cattle). Natural debris is ground and used for fuel at a co-generation trash burning plant and material that is already decayed is used for compost. Artificial material is disposed at an off-site landfill. The quantity of debris collected 2005 through 2010 is shown in Table 4.4.2.2-1.

#### 4.4.2.3 Holtwood Dam

A trash rake suspended from an overhead bridge crane is used to remove debris on unit intake screens. Wood and plastics are segregated and disposed of as wood only or plastics mixed with incidental station maintenance waste to the Lancaster County solid waste Management Authority. Holtwood estimates that 110 to 150 tons of wood debris is removed annually. Quantification of the amount of artificial debris removed is precluded because of the mixing with facility debris. Debris removal at the existing skimmer wall is hindered by accessibility. A new skimmer wall upstream of the station is being installed as part of the Holtwood Project expansion. This is will improve access to the river and debris removal.

### 4.4.3 Debris Management at Other Recent FERC Relicensing Projects

When available, debris management practices for FERC projects are readily accessible and represent current practices. Therefore, Exelon also reviewed debris management practices reported at projects that recently underwent FERC relicensing. To be relevant to the Conowingo Project, projects in the mid-Atlantic region of the country were examined (Claytor Lake Hydroelectric Project and Smith Mountain Hydroelectric Project, both in Virginia).

A Debris Management Study was prepared in support of Appalachian Power Company's Claytor Lake Hydroelectric Project near Blacksburg, Virginia (Kleinschmidt 2008b). At Claytor Lake, a 4,400 acre impoundment, debris removal is accomplished solely through a non-profit organization to which the facility donates equipment. These efforts are done on the impoundment prior to reaching facility intakes.

The Smith Mountain Hydroelectric Project, also in Virginia, impounds an area of 20,600 acres with a drainage area of approximately 1,029 square miles (Kleinschmidt 2008a). Debris removal within the impoundment is achieved with a mechanical skimmer boat. The lake area is so large and dendritic much of the debris never reaches the intakes for removal. Debris is generally removed within coves of the lake

where it collects rather than at the project intakes. During large debris flows a contractor provides additional removal capabilities.

In a survey of facility operators and debris management plans filed with FERC (described in a FERC filing related to the Smith Mountain Project proceeding) it is reported that hydroelectric facilities, in general, manage debris once it reaches forebays or intakes. Debris typically accumulates at overflow dams until high waters pass it downstream. Material will be physically removed by trash rakes or other equipment if it cannot be passed and may be hauled to a disposal facility. At reservoirs, facilities generally support volunteer clean-up efforts.

## 5.0 CONCLUSIONS

This study fulfills the three study objectives defined in Section 1.0.

1. Debris management activities to remove debris trapped behind Conowingo Dam take place under safe low flow conditions. The varying hydraulic capacities of upstream facilities, and varying contributing watershed areas to Conowingo Dam under different river flow conditions, combine to influence the amount of debris that reaches Conowingo Dam such that there is no direct relationship between river flow and the quantity of debris removed.

   At river flows under 31,500 cfs (hydraulic capacity of Holtwood) the debris trapped by Conowingo Dam originates from the tributaries of Conowingo Pond while Holtwood traps upstream debris. Additionally, much of the tributary debris is trapped at stream mouths and does not reach Conowingo.

   At flows greater than 31,500 cfs and less than 86,000 cfs (hydraulic capacity of Conowingo) the debris reaching and being trapped at Conowingo includes material that passes Holtwood as well as Conowingo Pond tributary debris. Since debris will not pass Safe Harbor until flows of 110,000 cfs are exceeded, the material passing Holtwood under these conditions is from tributaries to Lake Aldred. Once river flow exceeds 86,000 cfs, debris is no longer trapped at Conowingo but passes through the dam.

2. The review of the debris management practices of the three upstream facilities and other recent FERC relicensing projects indicates that the practices implemented at Conowingo Dam are similar to, and consistent with, the typical best management practices of other hydroelectric facilities.

3. Conowingo Dam practices are consistent with other facilities. Therefore, there is no need to institute additional practices..

**TABLE 4.2-1: QUANTITY OF DEBRIS COLLECTED AT CONOWINGO DAM (1989 - 1998)**

| Year | Volume Removed (cy) |
|---|---|
| 1989 | 4,350 |
| 1990 | 4,160 |
| 1991 | 2,960 |
| 1992 | 2,880 |
| 1993 | 3,000 |
| 1994 | 3,600 |
| 1995 | 0 |
| 1996 | 1,634 |
| 1997 | 60 |
| 1998 | 900 |

**TABLE 4.2-2: DEBRIS REMOVAL ACTIVITIES AT CONOWINGO DAM (2004 - 2010)**

| Year | Clamming | | Skimming | |
|---|---|---|---|---|
| | Days Active | Dumpster Loads[1] | Days Active | Skimmer Loads[1] |
| 2004 | 40 | - | 69 | - |
| 2005 | 75 | - | 3 | - |
| 2006 | 27 | 53 (636 cy) | 17 | 46 |
| 2007 | 45 | 71 (852 cy) | 3 | 15 |
| 2008 | 26 | 46 (552 cy) | 5 | 8 |
| 2009 | 43 | 88 (1,056 cy) | * | * |
| 2010 | 19 | 102 (2,040 cy)[2] | * | * |
| 2011[3] | 19 | 77 (1,540 cy)[2] | * | * |

[1] Each dumpster load is approximately 30 cy and each skimmer load is approximately 12 cy

[2] Each dumpster load is approximately 20 cy

[3] Through September 15, 2011

* Skimmer was retired in 2008.

**TABLE 4.3-1: IMPACTS OF UPSTREAM HYDRO FACILITIES ON DEBRIS REACHING CONOWINGO DAM AT VARYING RIVER FLOWS.**

| River Flow (cfs) * | York Haven (YH) | | Safe Harbor (SH) | | Holtwood (H) | | Conowingo (C) | |
|---|---|---|---|---|---|---|---|---|
| | Debris | Source | Debris | Source | Debris | Source | Debris | Source |
| <31,500 | passes | watershed upstream of YH (25,022 sq. miles) | trapped | watershed upstream of SH (26,090 sq. miles) | trapped | Lake Aldred watershed (696 sq. miles) | trapped | Conowingo Pond watershed (314 sq. miles) |
| >31,500 - 86,000 | passes | watershed upstream of YH (25,022 sq. miles) | trapped | watershed upstream of SH (26,090 sq. miles) | passes | Lake Aldred watershed (696 sq. miles) | trapped | Lake Aldred & Conowingo Pond watershed (1010 sq. miles) |
| > 86,000 - 110,000 | passes | watershed upstream of YH (25,022 sq. miles) | trapped | watershed upstream of SH (26,090 sq. miles) | passes | Lake Aldred watershed (696 sq. miles) | passes | Lake Aldred & Conowingo Pond watershed (1010 sq. miles) |
| > 110,000 | passes | watershed upstream of YH (25,022 sq. miles) | passes | watershed upstream of SH (26,090 sq. miles) | passes | watershed upstream of H (26,786 sq. miles) | passes | watershed upstream of C (27,100 sq. miles) |

* Hydraulic Capacities

31,500 cfs (H)

86,000 cfs (C)

110,000 cfs (SH)

**TABLE 4.4.2.2-1: VOLUME OF DEBRIS COLLECTED AT SAFE HARBOR DAM (2005-2010).**

| Year | Clamming (cu yds) |
|---|---|
| 2005 | 690 |
| 2006 | 4,545 |
| 2007 | 2,505 |
| 2008 | 4,545 |
| 2009 | 11,865 |
| 2010* | 5,610 |

*** Data through July 2010**
**Source: Safe Harbor Water Power Company**

**FIGURE 4.1.1-1: NATURAL DEBRIS ALONG THE EASTERN SHORELINE OF CONOWINGO POND (AUGUST 2010)**

**FIGURE 4.1.1-2: ACCUMULATION OF DEBRIS AT THE CONOWINGO DAM INTAKE STRUCTURE**

**FIGURE 4.1.1-3: LARGE LOG STRANDED ATOP BEDROCK ISLAND IN HOLTWOOD GORGE (OCTOBER 2006)**

**FIGURE 4.1.1-4: NATURAL DEBRIS STRANDED AT MT. JOHNSON ISLAND DURING LOW POOL LEVEL (JULY 2007)**

**FIGURE 4.1.1-5: DEBRIS COLLECTING AT A RAILROAD CULVERT OUTLET (JUNE 2008)**

**FIGURE 4.1.1-6: DEBRIS BUILD-UP IN SMALL CULVERT (SOFT BALL IN FOREGROUND) (JUNE 2008)**

**FIGURE 4.1.1-7: DEBRIS BUILD-UP AT TRIBUTARY CULVERT (SEPTEMBER 2007)**

**FIGURE 4.1.1-8: CLOSE-UP OF THE TRASH DEBRIS TRAPPED AT CULVERT (JULY 2008)**

**FIGURE 4.1.1-9: GREAT BLUE HERON USING DEBRIS TO REST AND FORAGE (JULY 2007)**

**FIGURE 4.1.1-10: CLOSE-UP OF GREAT BLUE HERON RESTING ON NATURAL DEBRIS (JULY 2007)**

**FIGURE 4.1.1-11: SMALL TERN RESTING ON FLOATING DEBRIS (SEPTEMBER 2007)**

**FIGURE 4.1.1-12: GREAT BLUE HERON CAPTURES SMALL FISH FROM SHORELINE DEBRIS (MAY 2007)**

**FIGURE 4.1.2-13: NATURAL AND ARTIFICIAL DEBRIS ON POINT BAR ACROSS FROM PEACH BOTTOM MARINA IN PETERS CREEK (MAY 2007)**

**FIGURE 4.1.2-2: ABANDONED DOCK NEAR MOUTH OF MUDDY CREEK (JULY 2008)**

**FIGURE 4.1.2-3: COLLAPSING CINDER BLOCK BULKHEAD (MAY 2008)**

**FIGURE 4.3-1: AVERAGE MONTHLY FLOW VS. ANNUAL QUANTITY OF DEBRIS COLLECTED (1989 THROUGH 2009)**

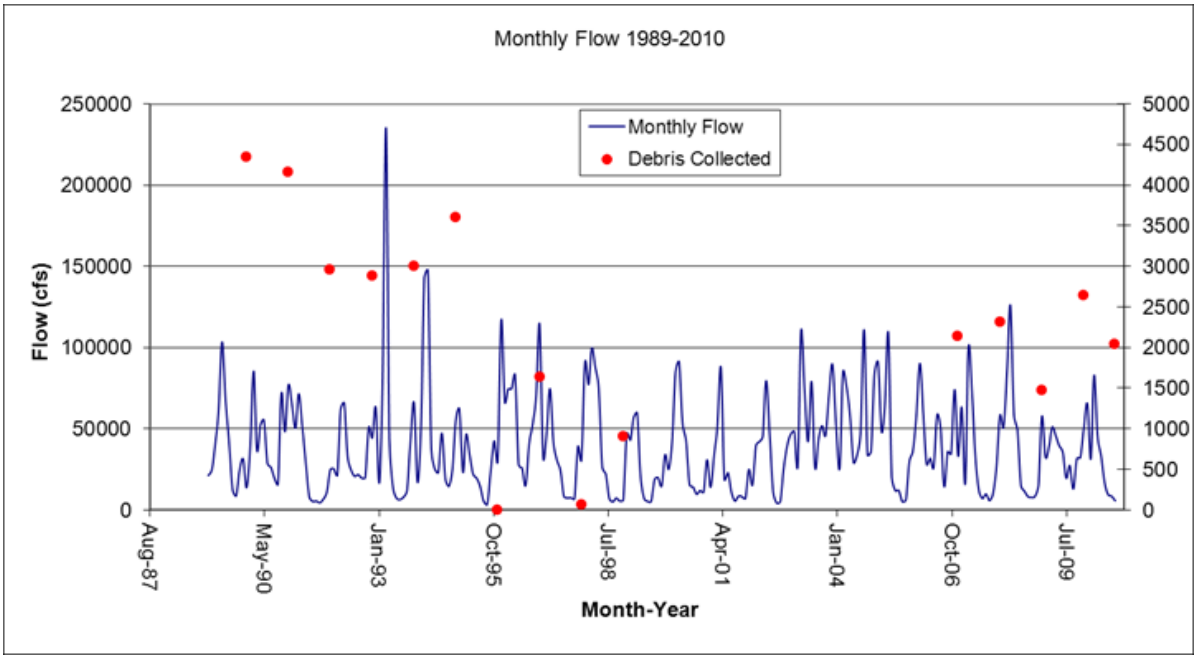


**FIGURE 4.3-2: DEBRIS WITHIN TRIBUTARY. RAILROAD CULVERT IN BACKGROUND (SEPT 2007)**

**FIGURE 4.3-3: DEBRIS WITHIN TRIBUTARY. RAILROAD CULVERT IN BACKGROUND (SEPT 2007)**

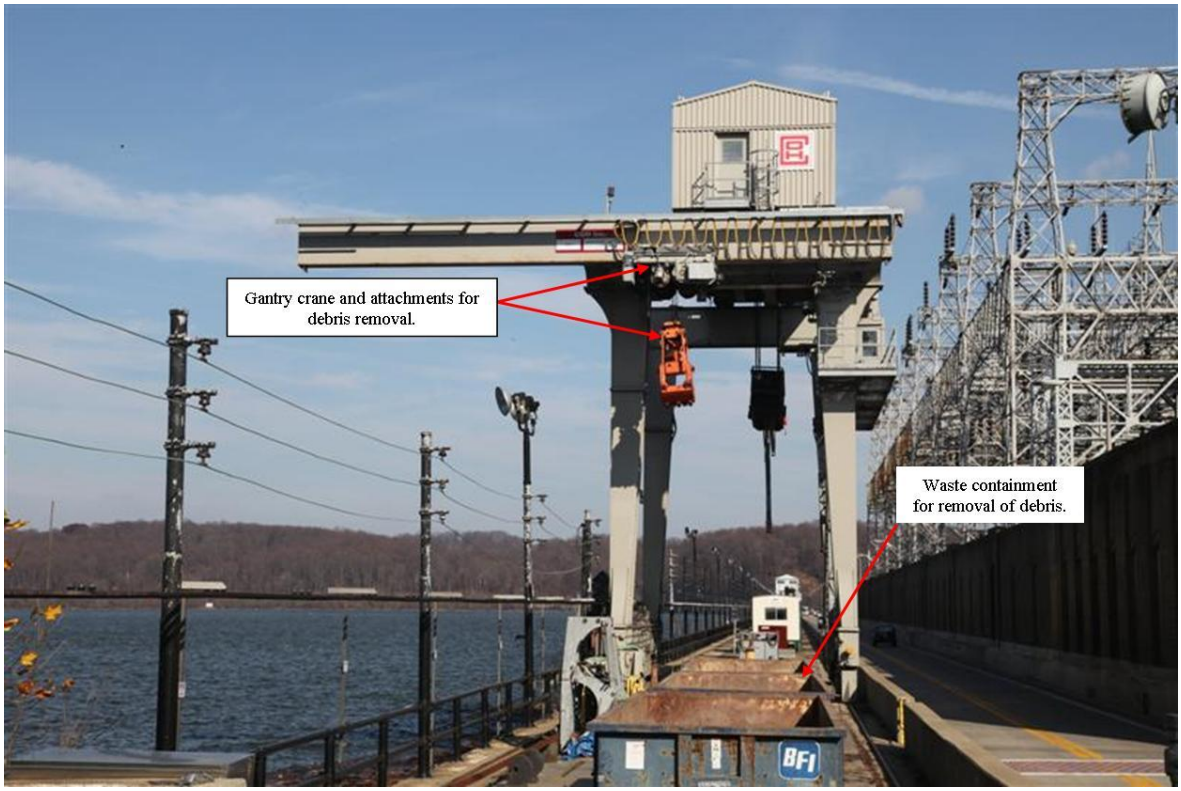


**FIGURE 4.4.1-1: DEBRIS REMOVAL EQUIPMENT USED AT CONOWINGO DAM**

## 6.0 REFERENCES


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**APPENDIX A-UPSTREAM DAM OWNER CONTACT LETTERS**

Exelon Power
300 Exelon Way
Kennett Square, PA 19348
Telephone 610.765.5826
Fax 610.765.5980
www.exeloncorp.com

Via Electronic Mail

Mr. Doug Weaver
York Haven Power Company, LLC
1 Hydro Park Drive and Locust Street
York Haven, PA 17370

RE: Request for Information on Debris Management Practices

Dear Doug,

We are requesting operational information in regards to debris management at your facility. As part of Exelon's ongoing FERC relicensing effort it was requested to identify the debris management practices of hydroelectric facilities upstream of Conowingo Dam and assess the impact on debris accumulation in the Conowingo Pond. This information will ultimately be used in the Debris Study Report submitted to FERC as an Initial Study Report.

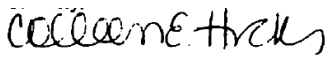
Please provide the following information as it pertains to your facility;

- Methods of debris removal
- Types of debris removed (wood, plastic, metal, etc)
- Source of debris disposal
- Quantity of material removed annually (past 5+ years)

Any additional information in regards to debris management at your facility would be welcomed.

If possible, your response to this matter by August 27, 2010 would be greatly appreciated. If you have any questions please feel free to contact Dr. Marjorie L. Zeff, 215-367-2549, marjorie_zeff@urscorp.com.

Respectfully submitted,



Colleen E. Hicks
Manager Regulatory and Licensing, Hydro
Exelon Power

Exelon Power
300 Exelon Way
Kennett Square, PA 19348
Telephone 610.765.5826
Fax 610.765.5980
www.exeloncorp.com

Via Electronic Mail

Mr. Juan Kimble, P.E.
President and Chief Executive Officer
Safe Harbor Water Power Corporation
1 Powerhouse Road
Conestoga, PA 17516

RE: Request for Information on Debris Management Practices

Dear Juan,

We are requesting operational information in regards to debris management at your facility. As part of Exelon's ongoing FERC relicensing effort it was requested to identify the debris management practices of hydroelectric facilities upstream of Conowingo Dam and assess the impact on debris accumulation in the Conowingo Pond. This information will ultimately be used in the Debris Study Report submitted to FERC as an Initial Study Report.

Please provide the following information as it pertains to your facility;

- Methods of debris removal
- Types of debris removed (wood, plastic, metal, etc)
- Source of debris disposal
- Quantity of material removed annually (past 5+ years)

Any additional information in regards to debris management at your facility would be welcomed.

If possible, your response to this matter by August 27, 2010 would be greatly appreciated. If you have any questions please feel free to contact Dr. Marjorie L. Zeff, 215-367-2549, marjorie_zeff@urscorp.com.

Respectfully submitted,

Colleen E. Hicks
Manager Regulatory and Licensing, Hydro
Exelon Power

Exelon Power
300 Exelon Way
Kennett Square, PA 19348
Telephone 610.765.5826
Fax 610.765.5980
www.exeloncorp.com

Via Electronic Mail

Mr. Christian N. Porse
Site Supervisor
PPL Holtwood LLC
482 Old Holtwood Road
Holtwood, PA 17532

RE: Request for Information on Debris Management Practices

Dear Chris,

We are requesting operational information in regards to debris management at your facility. As part of Exelon's ongoing FERC relicensing effort it was requested to identify the debris management practices of hydroelectric facilities upstream of Conowingo Dam and assess the impact on debris accumulation in the Conowingo Pond. This information will ultimately be used in the Debris Study Report submitted to FERC as an Initial Study Report.

Please provide the following information as it pertains to your facility;

- Methods of debris removal
- Types of debris removed (wood, plastic, metal, etc)
- Source of debris disposal
- Quantity of material removed annually (past 5+ years)

Any additional information in regards to debris management at your facility would be welcomed.

If possible, your response to this matter by August 27, 2010 would be greatly appreciated. If you have any questions please feel free to contact Dr. Marjorie L. Zeff, 215-367-2549, marjorie_zeff@urscorp.com.

Respectfully,

Colleen E. Hicks
Manager Regulatory and Licensing, Hydro
Exelon Power

**APPENDIX B-UPSTREAM DAM OWNER RESPONSE LETTERS**

YHPC, LLC.
*Water Power for the Future*
*http//www.yorkhavenpower.com*

**York Haven Hydro Station**
Hydro Park Drive & Locust Street
PO Box 67
York Haven, PA 17370

717-266-6454
717-266-9472 (fax)

October 9, 2010

Colleen E. Hicks
Manager, Regulatory and Licensing, Hydro
Exelon Power
300 Exelon Way
Kennett Square, PA 19348

Re: Request for Information on Debris Management Practices

Dear Ms. Hicks:

This letter responds to your letter transmitted via e-mail on August 5, 2010, requesting information concerning the debris management practices at the York Haven Project.

The York Haven Project has only limited capacity to intercept and remove debris emanating from the upstream drainage area. As you are aware, the York Haven Project is the most upstream of the four hydroelectric projects on the lower Susquehanna River, and receives water from a drainage basin of 24,973 square miles above the project (representing nearly 40,000 linear miles of streams. The Project has a 20-unit facility with 7 vertical turbine generators and 13 horizontal units, having a combined installed capacity of 19.650 kW.

Compared to other hydro facilities on the Susquehanna mainstem, the configuration of the York Haven project is unusual. The headrace is formed by a 3,000 foot stone masonry wall that extends north from the powerhouse to the main dam. The powerhouse sits within the river, aligned parallel to natural river flow. The concrete-covered, rock-filled dam extends from the end of the headrace's masonry wall in the western portion of the River for approximately 5,000 feet in a northeast direction to Three Mile Island, with a maximum height of 17 feet and an average height of 10 feet; and a gravity overflow dam, known as the East Channel Dam, extends approximately 950 feet from the east shore of Three Mile Island to the east bank of the River.

The Susquehanna River Basin Commission has estimated that approximately 90 percent of river debris is transported during high flow, as it is during these times that the shorelines of the mainstem and tributaries are scoured. When river flow exceeds the York Haven project's hydraulic capacity of 16,000 cfs, which is approximately 63 percent of the time, water is spilled over the Project's two dams, and most of the river-borne debris is carried naturally downstream.

Only a small portion of the river-borne debris enters the York Haven Project's headrace annually. In 1985, the Project's operators estimated that roughly 5,000 cubic yards, or 1,300 tons of debris, enters the headrace on an annual basis. The preponderance of this material (over 90 percent) is leaves, grass, twigs and shorter food material. Man-made material accounts for an estimated 5 percent of the total, and includes tires, plastics, bottles, cans, parts of structures (such as piers, wharves and bulkheads) and an occasional appliance or steel drum. The remaining material involves larger trees and an occasional land animal carcass.

The existing debris management at the York Haven Project is focused on keeping the trash racks that protect the generating units in good working order, and clearing the forebay to provide unrestricted flow to the units so as to minimize head losses and maintain engineering integrity. The intake structure is constructed on the upstream face of the powerhouse and is approximately 25 feet tall. The intake structure is protected by a trashrack that slopes at approximately 30 degrees from vertical. The rack cleaning is performed by a trash rake, where raking teeth are moved up and down the trash rack. Because the original powerhouse design called for manual raking, the platform above the intake structure is very narrow.

Debris on the trashrack is guided down the face of the sluice by the trash rake. Once the rake is near the sluice gate, the sluice gate is opened and debris from the trash rakes and in the forebay is returned to the river. The project makes reasonable efforts to remove man-made trash from the forebay prior to opening the sluice, although in high flow conditions not all of such debris is safely accessible.

Debris management at the York Haven Project continues to be a labor-intensive activity, including efforts by operators using chainsaws attached to long, stout poles to cut up logs. York Haven routinely collects and disposes of debris at recreational use areas, and uses boats and divers to collect trash upstream of the channel. Although we do not have specific records of the amount of debris removed from the river, we would estimate it to be in the range of up to 25 cubic yards per year.

The limitations confronted by the York Haven Project in terms of debris management and removal capability have been discussed in some detail with the Pennsylvania Department of Environmental Protection ("PaDEP"). These discussions led to the conclusion that, given the hydraulic and engineering limits confronted at this site, York Haven is implementing the maximum practicable program.

Should you have any questions regarding the above response, please contact me at your convenience.

Sincerely,

*D E Weaver /s*

Douglas E Weaver

Douglas Weaver
Project Manager

Enclosures

# Safe Harbor Water Power Corporation

1 POWERHOUSE ROAD, CONESTOGA, PA 17516-9651 ■ Telephone 717-872-0225 ■ Fax 717-872-0223

JUAN A. KIMBLE
PRESIDENT AND & CEO

Email
jkimble@shwpc.com
http://www.shwpc.com



August 11, 2010

Ms. Colleen E. Hicks
Manager Regulatory and Licensing, Hydro
Exelon Power
300 Exelon Way
Kennett Square, PA 19348

***Request for Information on Debris Management Practices***

Dear Ms. Hicks:

Please find the following response to your request for our debris operational information:

- Methods of debris removal: Clam shelling at our skimmer wall and unit intakes and trash rake operation on unit intake screens.

- Types of debris removed: Natural tree wood, tree foliage and grasses; manmade trash (i.e. bottles, appliances, LP gas tanks, tires & rims, plastic 55 gal. drums, etc.) and dead animals (deer, pigs, fish, turtles, birds, cattle, etc.)

- Source of debris disposal: Natural tree wood, tree foliage and grasses are reduced in size by an industrial grinding machine by an outside contractor with most of the decayed material removed. The ground natural materials are used for fuel at a co-generation trash burning plant. The wood grinding contractor uses the decayed natural material along with other soil to create top soil.
  All manmade materials removed from the natural materials including the tires and rims are disposed of at a landfill.

- Quantities of materials removed annually estimated in cubic yards:

| | |
|---|---|
| 2005: | 690 |
| 2006: | 4,545 |
| 2007: | 2,505 |
| 2008: | 4,545 |
| 2009: | 11,865 |
| Year to date July 2010: | 5,610 |

The above information is the current process at Safe Harbor. I hope this data is helpful for your study.

Sincerely,

Juan A. Kimble

Copy: Guy W. Hager
John H. Kaufman, Jr.
Ted C. Rineer

**PPL Holtwood, LLC**
482 Old Holtwood Road
Holtwood, PA 17532-9720
Tel. 717.284.6200 Fax 717.284.6234
ncporse@pplweb.com

November 8, 2010



Ms. Colleen E. Hicks
Manager Regulatory and Licensing, Hydro
Exelon Power
300 Exelon Way
Kennett Square, PA 19348

Re: Request for Information on Debris Management Practices

Dear Colleen,

As requested I am providing information on the debris handling and disposal practices at the PPL Holtwood Hydroelectric Station.

- Methods of debris removal

  Debris is removed from the hydroelectric unit intake trash screens by raking the screens. A trash rake suspended from an overhead bridge crane is utilized. Debris removal at the skimmer wall is hampered by accessibility and overflow conditions on the dam.

- Types of debris removed (wood, plastic, metal, etc.)

  All manner of wood and plastic materials are collected and disposed. Materials are segregated and disposed either as wood only or plastics that are mixed with plant incidental maintenance waste.

- Source of debris disposal

  All materials are handled by Lancaster County Solid Waste Management Authority.

- Quantity of material removed annually

  Wood debris removed annually averages 100 to 150 tons. Other man-made debris cannot be quantified due to mixing with plant incidental maintenance waste.

As you are aware, the expansion project is currently in process at Holtwood. Included in the work scope is a new skimmer wall upstream of the plant that will provide improved equipment access to the river area. As identified in the agreement between Exelon Power and PPL Holtwood LLC, future efforts at debris removal at Holtwood will be undertaken as a result of the improved access.

I trust this provides the information needed. If you have further questions, please contact me.

Sincerely,

N. Christian Porse
Site Supervisor
PPL Holtwood LLC

cc: M. Bennett PPL
P. Hackenbrack PPL