Pictou Landing Band Office
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February 17, 2016 File No. 8364-001

His Honour Judge Del Atwood
Nova Scotia Provincial Court
69 Water St., PO Box 1750
Pictou, NS B0K 1H0

Your Honour,

R. v. Northern Pulp Nova Scotia Corporation —Fisheries Act s. 36(3) – Victim Impact Statement

INTRODUCTION

Thank you for asking to hear from Pictou Landing First Nation before sentencing Northern Pulp for discharging industrial effluent into the East River contrary to section 36(3) of the Fisheries Act. I cannot express how much it means to our community to be recognized in this way.

This was not a victimless offence. The discharge of effluent from a leak in the 50 year old pipeline on June 10, 2014 was simply the latest environmental insult to the traditional territory of the Pictou Landing First Nation.

We will never know the actual impact that the deposit of 4 million litres of toxic effluent into the East River that day has had or will have on fish and fish habitat. We do know that the social, psychological and cultural impact on the members of our community was intense and will persist.

The spill triggered anger and fear which can only be understood as part of the decades-long environmental degradation of our territory which began with the construction in 1967 of a pipeline to carry effluent from the new pulp mill at Abercrombie Point. The pipeline was routed across lands over which our First Nation has asserted a compelling claim for Aboriginal title. This land was never the subject of a Crown grant but somehow became the subject of private deeds exchanged between settlers in the area.

In 1967 the Province of Nova Scotia purported to expropriate an easement over the burial grounds at Indian Cross Point for the pipeline but as we now know lands subject to Aboriginal title cannot be expropriated by the Province. The pipeline was unlawfully installed on our burial

grounds and remained there unlawfully up to June 10, 2014 when the pipeline burst despite the protections afforded us in s.35 of the Constitution Act, 1982.

To make matters worse, the pipeline carried the effluent to Boat Harbour which is adjacent to our Reserve and to which we also lay claim by virtue of Aboriginal title and the common law of riparian rights. The effluent has hovered like a ghost over the community for decades causing odours and health concerns.

The spill on June 10, 2014 was foreseeable. In 2009 the entire section of the pipeline lying under the East River was replaced following an earlier leak that discharged raw effluent into the East River. The new section ended less than 500 feet from the area that ruptured on June 10, 2014. The recent spill could have been prevented had the pipeline been completed replaced in 2009. Instead the company rolled the dice with the environment.

In fact the company continues to roll the dice. Northern Pulp did not replace the pipeline in 2014, it only repaired the leak in that one spot. The remainder of the pipeline from the East River to Boat Harbour remains as originally installed in 1967. Given its proximity to the river it poses a continued threat to fish habitat if the pipeline were to spring another leak.

Our community has always been a fishing community. We now have an extensive lobster fishery in the Northumberland Strait. We also have a smaller food and ceremonial fishery which includes gaspereau and salmon fishing in the East River. We operate our fisheries in a sustainable way keeping in mind our environmental responsibility. We have been involved in several initiates to improve fish habitat and the fishery in our area. Our initiatives are limited only by availability of funds.

HISTORY

New Pulp Mill

In 1965 Scott Maritimes proposed a new pulp mill at Abercrombie Point and needed a place to discharge the 25 million gallons of effluent that the mill would generate daily. The Province agreed to provide a facility to receive and treat the effluent for the next 25 years. The Province identified Boat Harbour as the site for a new treatment facility as only a "small Band of Indians" would be affected by it.

Misrepresentations as to expected condition of Boat Harbour

On August 25, 1965 a representative of the Nova Scotia Water Authority, Mr. A. F. Wigglesworth, met with members of Pictou Landing First Nation at a public meeting held on the Reserve. The meeting was chaired by a representative of Indian Affairs (Canada) (Tabs 1 and 2).

At the meeting all members present were against the proposal. in the records show that in particular members were upset about: (a) the loss of clams, quahogs, eels, smelt, lobster and trout; (b) the loss of feeding grounds for ducks and geese; (c) the loss of a safe anchorage for their boats; (d) the loss of the use of the water for swimming and recreational sport; (e) odors blowing off the water onto residential areas of the Reserve less than a quarter of a mile away; (f) loss of future building lots along the Boat Harbour shoreline; and (g) lack of consideration for the feelings of members over the ruination of land which they considered their own.

It was pointed out to Mr. Wigglesworth at the meeting that other Mi'kmaq from across Nova Scotia would travel to the Reserve to relax and enjoy the sport of fishing in Boat Harbour. It was further pointed out by Chief Louis Francis that he felt that there was an historical treaty which gave the Mi'kmaq the exclusive right to fish in Boat Harbour. Some non-Native residents of Pictou Landing were present at the meeting and it came out that non-Natives had respected the use of Boat Harbour by the Mi'kmaq over the years.

Mr. Wigglesworth told those present at the meeting that Boat Harbour would be dammed and the water levels maintained at the high water mark creating a lake. He said that no salt water fish would survive but he believed that the water may be suitable for freshwater fish. He also gave the opinion there would be no odor from the treatment facility except in the Spring when the ice broke up.

Similar representations were made on other occasions to non-Native residents in the area. They were told that Boat Harbour would become a beautiful fresh water lake suitable for boating and waterskiing and that a skid way would be installed to accommodate boats going in and out of Boat Harbour (Tab 3).

After hearing the objections of members of the Pictou Landing First Nation, the Province began to consider whether Pictou Landing First Nation could be "bought off" with cash (Tab 4).

On the weekend of October 10, 1965, Mr. Wigglesworth took Chief Francis and Councillor Martin Sapier to Renforth, New Brunswick and showed them a domestic sewage disposal system that had just been constructed. Mr. Wigglesworth falsely told them that the system was similar to the industrial wastewater facility proposed for Boat Harbour. The Chief and the Councillor were impressed that the Renforth system had no odor (Tab 5) but were not told that the system had not yet gone into operation. Chief Francis and Councillor Sapier were asked to sign a handwritten "agreement in principle" which they did on Sunday, October 10, 1965 while they were still in Saint John, New Brunswick. The two men were motivated by the belief that the new pulp mill would be good for the entire area of Pictou County (Tab 6).

Later a Band Council Resolution was obtained purporting to consent to the project (Tab 7).

1966 Federal Order-in-Council

The Province acquired land adjacent to Boat Harbour by purchase from private landowners. However, the Pictou Landing First Nation's Reserve also bounded Boat Harbour but no interest in Reserve land could be transferred unless the provisions of the Indian Act were followed. There were two options: (1) a surrender to the Federal Government under s. 38 of the Indian Act; or (2) a transfer in lieu of expropriation under s. 35. Surrender would have required the affirmative vote of a majority of the electors of the Pictou Landing First Nation at a duly called meeting or in a formal referendum. No meeting or referendum took place. Transfer in lieu of expropriation would have required a Provincial enactment authorizing the expropriation. No such enactment existed.

Nonetheless, by Federal Order-in-Council dated September 2, 1966 Canada purported to transfer the riparian rights in and to the waters of Boat Harbour relating to the Reserve to the Province (Tab 8). While Chief and Council did pass a band council resolution sometime around October 22, 1965 consenting to the transfer (Tab 7), this fell short of the requirements of a valid surrender or transfer in lieu of expropriation. Accordingly, the riparian rights of the Pictou Landing First Nation remained intact.

Pipeline built through Indian Cross Point

In 1966 and 1967 the pipeline was built as planned. It passed under the East River and emerged onto the burial grounds at Indian Cross Point. No consent was even sought for this trespass. Our community felt helpless and was horrified by the many rumours of contractors finding human remains in the area during construction of the pipeline.

Terms of the 1966 Order in Council Ignored

One of the conditions attached to the 1966 Order-in-Council was that the Province take remedial action should the water in Boat Harbour become septic (Tab 8).

Submissions by local citizens to an engineering consulting firm hired to study the problem at the time shows that conditions in and around Boat Harbour deteriorated almost immediately after the wastewater began to flow from the pulp mill in 1967 (Tabs 9, 10, 11).

A 1970 Health Canada investigation revealed that Boat Harbour had lost all of its original characteristics and was merely a retention pond and that oxygen demand caused by the wastewater exceeded the available oxygen in the system (Tab 12). That same year the Department of Fisheries and Forestry (Canada) reported that results of investigations conducted since 1967 showed a progressive concentration of pollutants in Boat Harbour (Tab 12). Boat Harbour had become septic.

While the Province took some measures to alleviate the conditions in Boat Harbour later in the 1970's, septic conditions remained and continue to this day, adversely impacting the use and enjoyment of Boat Harbour and the Reserve lands (Tabs 13, 14, 15).

Adverse Health Effects

One of the most noticeable impacts on the community has been the odor. Odors from the wastewater treatment facility are caused in part by sulphur compounds and mercaptins (Tab 16). As early as 1970 a local physician, Dr. MacDonald raised concerns about the health effects of the sulphur gasses on residents in the area. Dr. MacDonald's concerns were validated by later studies which showed that people living near pulp mills and exposed to airborne sulphur compounds have a higher incidence of adverse health effects. These studies are reviewed in a journal article, The Science of Odor as a Potential Health Issue by Susan S. Schiffman and C. M. Williams, J. Environ. Qual., Vol. 34, January 2005 (Tab 17).

1991 Promise to Decommission the Wastewater Facility and remediate Boat Harbour

It was not until February 12, 1991 in a letter from the Nova Scotia Minister of Environment to the Minster of Indian Affairs (Canada) (Tab 18) that the Province committed to closing the wastewater treatment facility and returning Boat Harbour to a tidal estuary. Boat Harbour was to close within 5 years.

1995 Promise to Decommission the Wastewater Facility and remediate Boat Harbour

However, four years later in September 1995, the Province convinced Pictou Landing First Nation to permit the treatment facility to continue to operate for a further 10 years (Tab 19) and promised to remediate Boat Harbour after December 31, 2005.

Indian Cross Point

In 1998 the Province received a report on Indian Cross Point in an effort to pinpoint the location of burial plots. The study identified an area of 50 acres that had never been the subject of a Crown grant and was identified as burial grounds on maps dating back to the mid-1700's (Tab 20).

Proposed By-Pass Pipeline

In 2000, the Province and the mill owners convinced Pictou Landing First Nation to allow the treatment facility to remain open beyond the planned December 31, 2005 closure date. To accomplish this, the owner of the mill promised to build a second pipeline to carry treated effluent from the upper reaches of Boat Harbour through Boat Harbour and into the Northumberland Strait. It was said that this would allow most of Boat Harbour to be

remediated and the dam at the entrance to the harbour to be removed so that Boat Harbour would become tidal once again. This by-pass pipeline was to be completed by December 31, 2005. The upper reaches of Boat Harbour, which had earlier been separated from the main waters of Boat Harbour, would continue to be used as part of the treatment facility. The Province and the owner of the mill promised that after 2030 the wastewater facility would be decommissioned in its entirety and the area remediated.

December 31, 2005 – No Closure

However, by December 31, 2005, plans for the new pipeline were placed on hold. The Province and the mill owner cited anticipated difficulties in getting environmental approval for the project.

Extension of time

The Province and the owner of the mill asked Pictou Landing First Nation to push back the deadline for the pipeline project from December 31, 2005 to December 31, 2008. Pictou Landing First Nation agreed. This gave the Province and the mill owner another 3 years to find an alternative to the proposed by-pass pipeline.

No alternative to by-pass pipeline

However, by October 2008 neither the Province nor Northern Pulp had found an alternative plan that would allow the treatment facility to continue to operate while Boat Harbour was remediated and returned to tidal.

No more extensions

On November 19, 2008 Chief Anne Francis-Muise wrote to the Province detailing the adverse impacts of the wastewater facility on Pictou Landing First Nation and insisting that the Province close the facility within a reasonable period of time and remediate Boat Harbour as promised (Tab 21). Enough was enough.

December 4, 2008 Commitment

In response, three Provincial Cabinet Ministers met with Chief Francis-Muise on December 2, 2008. At the meeting they advised Chief Francis that the Province would close the wastewater facility within a reasonable period of time. The commitment was later documented in a letter dated December 4, 2008 (Tab 22).

The December 4, 2008 letter acknowledged the adverse impacts on Pictou Landing First Nation members and confirmed the Province's commitment to find another location for the treatment facility and to clean up Boat Harbour:

We welcomed the opportunity to confirm, in a face to face meeting, among leaders of both governments the Province's intention to end the negative impacts on your community caused by the Boat Harbour Effluent Treatment Facility.

As Minister Baker so graphically stated: "To say that the Band has been long suffering would be a masterful understatement of the obvious." It is our unwavering intention to end that suffering as quickly as possible. It should have been done a long time ago.

Our first step will be to find another discharge location that does not involve Boat Harbour. We will then clean the harbour and return it to a tidal state."

The Province appointed a negotiator shortly after December 4, 2008 to work out the details of the closure of the treatment facility and the remediation of Boat Harbour. However, on June 9, 2009 the New Democratic Party formed the government after a Provincial General Election and negotiations were put on hold while the new government "studied" the matter.

2009 Pipeline Leak

It was around this time in 2009 that the entire section of the pipeline under the East River was replaced following the escape of effluent into the East River from a rupture. The age of the pipeline was cited as the reason for the leak. To our knowledge no charges were laid against Northern Pulp at that time although the company made a most contribution to fish habitat protection. However, no steps were taken to replace the section of pipeline that continued eastward from the East River over the burial grounds at Indian Cross Point despite then advancing age of the pipeline in that area as well.

2010 Law Suit

The Province ultimately decided not to honour the letter of December 4, 2008 in which it promised to close and remediate Boat Harbour. This led to a lawsuit against the Province and Northern Pulp which is still before the Nova Scotia Supreme Court.

STATUS AS OF JANUARY 2014

In evidence before the Nova Scotia Supreme Court on a motion for advance costs, I set out in an affidavit the effect of the pulp mill on the community up to that point:

The wastewater treatment facility has been like a heavy weight dragging down the community – physically, emotionally, spiritually, culturally, socially and economically - for decades. The community has lost hope and trust after decades of broken promises by the Province and the owners of the mill.

We were resigned to the fact that the only way forward was the lawsuit that we had commenced.

2014 PIPELINE LEAK

It was not long after I made those remarks that the leak which brought this matter before this Court occurred on the morning of June 10, 2014. I first became aware of the leak on social media. I immediately went to the site to survey the damage. I was very alarmed to see the effluent flowing so quickly onto the land and into the waters of the East River. It was heartbreaking and terrifying at the same time. I was very disturbed and disappointed that the community had not been contacted by Northern Pulp about the leak and that the company was planning to move ahead with remediation without consulting us about the potential impacts of the raw effluent on the land and water. I saw for myself that vast amounts of the effluent had escaped from the underground pipeline. It had eroded a large area as it flowed over Indian Cross Point and into the East River itself. The waters of the East River were discolored where the effluent had entered.

IMPACT ON THE COMMUNITY

As the news spread throughout the community, there was concern about destruction of the burial grounds and contamination of the river. Our community is downstream from Indian Cross Point at the mouth of the East River.

The community has large commercial fishery operation as well as a food and ceremonial fishery. The spill occurred in the middle of lobster season. While there were no traps in the immediate area, there was concern about the impact on the lobster fishery further out to sea.

The spill put Indian Cross Point back in the spotlight and reminded the community that the pipeline had been unlawfully buried at Indian Cross Point without our consent. We considered it as part of our territory even though it had not been formally recognized at the time.

The spill also sparked outrage in the community because it was so closely connected to the Boat Harbour treatment facility. Band Council organized a blockade of the right of way leading to the spill site. The blockade had the full support of the community and members took turns at the blockade. The community received support from the broader community but also received

threatening messages as well. Some Pictou Landing First Nation members feared that closure of the mill might be blamed on them.

Pictou Landing First Nation invited the Mi'kmaq Conservation Group to investigate the physical impacts of the spill. The MCG called for further investigation, monitoring and baseline testing of the fish stocks in the area (Tab 23).

We recently gathered on February 16, 2016 at a community meeting to talk about the impact of the effluent spill so that we could better prepare this statement. As Mi'kmaq we look at the world as four parts of a complete circle. The four parts represent the physical, the mental, the spiritual and the emotional. The impact of the 2014 pipeline leak has affected all four areas and was captured on a circle diagram made during the community meeting (Tab 24).

The community members reported having been afraid of contamination in the river. They felt like victims all over again. They felt like they had let the environment down. They felt helpless. The Province has propped up the mill for so many years and still owns the pipeline. No charges were ever laid by the Province against Norther Pulp under the Environment Act or otherwise. They questioned why Northern Pulp was not held responsible. They asked why Northern Pulp was not required to replace the entire pipeline in the area of Indian Cross Point. They worry that another leak could occur again.

On a positive note, the community members acknowledged that the spill led to a blockade which shut down the mill for two weeks. While the mill was closed the community felt relief. The air pollution from the mill had stopped and the odours from Boat Harbour were not as strong as they had been. Members felt empowered by the blockade and more optimistic about the environment when the mill was closed.

The blockade also led to an agreement in principle with the Province to end the use of the Boat Harbour treatment facility and to remediate Boat Harbour. In March 2015 the Boat Harbour Act was passed which legislates the end of the use of Boat Harbour as an effluent treatment facility as of January 30, 2020.

However, these positive results of the spill are incidental and can in no way mitigate or excuse the offence which has taken place.

PICTOU LANDING FIST NATION FISH HABITAT

As noted in the MSG report cited above, further investigations, monitoring and baseline testing of fish stocks are recommended. As well we have identified much needed fish habitat restoration work and projects to improve the fishery.

Unfortunately Pictou Landing First Nation receives the bulk of its revenues from the Federal Government. As recently determined recently by the Canada Human Rights Tribunal in First Nations and Family Caring Society et al. v. Canada, 2016 CHRT 2, First Nations in Canada are chronically underfunded when it comes to social programs (in that case child welfare was found to be underfunded by 38% compared to non-First Nation Canadians). We have no room in our operational budget for further investigation, modelling and baseline testing as recommended by MCG or for habitat restoration or projects to improve the fisheries.

We hope that any sentencing includes an order under section 79.2 of the Fisheries Act requiring Northern Pulp to pay funds to Pictou Landing First Nation for the purpose of "promoting the proper management and control of fisheries or fish habitat or the conservation and protection of fish or fish habitat".

SUMMARY

This was not a victimless offence. As you can see from the above, there has been a long history of broken promises to our community relating to the operation of the mill. Our concerns about our environment and our health have been ignored. This has taken a toll on our dignity.

Our claim to Indian Cross Point and the lands under the East River are strong. Yet the pipeline is still there, running through our burial grounds. Section 35 of the Constitution Act, 1982 protects our Aboriginal rights and our title to the land at Indian Cross Point including our riparian rights to the waters of the East River. Because the leak was predictable in a 50 year old pipeline after the 2008 we can only assume that the decision not to replace the pipeline was taken for financial reasons. Profits were put ahead of our Constitutional rights.

I leave you with the words of Lieutenant Governor Johnathon Belcher, who would later become the Chief Justice of Nova Scotia, delivered to our ancestors on the occasion of the signing of the Treaty of Peace and Friendship of 1761:

> The Laws will be like a great Hedge about your Rights and Properties, if any break this Hedge to hurt and injure you, the heavy weight of the laws will fall upon them, and punish their disobedience.

Wela'lin,

Chief Andrea Paul

Chief Andrea Paul

MEMORANDUM

CLASSIFICATION

Maritime Regional Office

YOUR FILE No.
Votre dossier

OUR FILE No. 51/8-17
Notre dossier

FROM Superintendent
De Shubenacadie Indian Agency

DATE Aug.26, 1965.

SUBJECT Meeting on Pictou Landing Reserve
Sujet re proposed use of Boat Harbour for waste water treatment project.

As indicated my letter August 18th to your office, a meeting with Mr. A.F. Wigglesworth, General Manager of the Nova Scotia Water Authority and a fair representation of Band members, some twenty in all, with a full Council, was held at the reserve Community Hall on Pictou Landing From 8.00 to 9.15 P.M. last night.

On request from the Chief, I acted as Chairman and Assistant R.D. Brown took notes. Mr. Wigglesworth came alone and W. A. MacDonald represented M.R.O. as an observer.

After the purpose of the meeting was explained, I introduced Mr. Wiggleworth, who went into some detail with regard to the proposed project and how it would effect Boat Harbour. It was somewhere along here that voices were raised as there were four non-Indians (neighbours of reserve residents), who as land owners around Boat Harbour sat in on the meeting - with the permission of the Band. Unfortunately they, as well as a number of the Indians were somewhat intoxicated which made the meeting a bit hard to control, however, it did not get out of hand but it was a bit hard to concentrate on the business of the evening for a brief period. From there on it was fairly smoothe.

It was quite natural and of course expected for the Band to raise strong objections to anyone who might try to spoil their continued use of Boat Harbour by contaminating its water. Our purpose was to make a list of the reasons as put forth by the Indians themselves in order of importance - why the Harbour should not be disturbed. In other words, state the Indian objections and present them to Ottawa for top level consideration.

Through Chief Louis J. Francis and Councillors John Prosper and Martin Sapier the following objections were raised:

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1. Fishing as a source of food would be lost for ever. The actual value of this is not known as very little is sold, but as an always available source for such fish as clams, quahog's, eels, smelt, lobster and trout for which they estimate an unusual value of $15,000.00

2. Continued high water level and contamination would ruin feeding ground or mud flats for large numbers of game birds such as ducks and geese, an important source of food and when combined with the sport value they state is worth an annual $10,000.00.

3. The harbour would be lost as a safe anchorage for their fishing boats.

4. The waters could no longer be used for swimming and recreational sports as it would be discoloured and contaminated.

5. Odors would at times be blowing off the waters on to residential area of reserve less than a quarter mile away in some cases.

6. Loss of possible building lots on Boat Harbour shoreline.

7. Last but not least, no consideration seems to have been given for the feelings of the Indian people by authorities proposing to ruin for ever an area considered by the Micmac people to be their very own.

In summing up it was quite evident to see that 100% of those present, and assurance was given by the Council that other Micmac Indians of various reserves in Nova Scotia who come there to fish and enjoy the sport and relaxation of Boat Harbour would certainly raise a united objection, to any termination of their long established way of life.

The Chief believes that there is an old treaty on record somewhere that gives the Micmac people exclusive fishing rights of Boat Harbour. This would be an important document if it can be found.

It is the request of the Council that Indian Affairs Branch give immediate consideration to their way of reasoning and successfully defend their interests against the proposed project of the Nova Scotia Water Authority.

Whilst the route of the planned 4 foot pipeline from the Abercrombie Mill carrying 23 million gallons of waste daily across the bay (part of Pictou Harbour) is not known - it is thought that it would almost certainly cross reserve land in the overland route of the disposal area.

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MEMORANDUM

CLASSIFICATION

TO A: Mr. F.B. McKinnon,
Regional Director.

YOUR FILE No. Votre dossier:

OUR FILE No. Notre dossier: 51/8-17 (256)

FROM De: Regional Development Officer

DATE: Sept. 9th/65

LO

SUBJECT Sujet: Meeting at Pictou Landing Reserve re Use of Boat Harbour, Aug. 25th.

Present at this meeting were about 18 residents of the Pictou Landing Reserve along with Mr. Clench, Mr. Brown, Mr. Wigglesworth, and the undersigned. Mr. Wigglesworth explained that the Abercrombie Mill was a new industry coming to Pictou County and the Provincial Water Authority had to plan for providing the mill with 23,000,000 gallons of water a day and the disposal of the plant affluent which would equal the same amount. He explained that the pulp is broken down through the use of caustic soda, but it is neutralized by chlorine and this does not create a problem. The problem comes from the fact that there are many chips from the wood which are rejected and these must be disposed off.

A pipe line could be built out the harbour but the chips would float ashore and contaminate the beaches around Pictou Harbour. They also could make a lagoon but believe the use of Boat Harbour would be the best solution to the problem. The Harbour would be dammed up to the present high tide level and would make a lake. All the salt water fish would disappear, but he believes fresh water fish would be still there. He gave the opinion that there would be no odor from this lagoon except in the spring when the ice breaks up. About this time, a white woman from Pictou Landing, Mrs. John Rand, began to heckle and said that she was never informed of the meeting. About five more Indians came in, making the total around 23 and quite a bit of hubbub ensued.

Mrs. Rand began insisting that the use of the Harbour would affect her more than the Indians and after some time, she calmed down when it became clear to her that the meeting was called to discuss the matter with the Indians of Pictou Landing and not the non-Indians who also owned property around Boat Harbour.

Some discussion took place as to whether the Water Authority would repay the Indians for the loss of fishing rights. Some of the Indians felt that Boat Harbour was guaranteed to them in treaty. It did come out of the meeting that the non-Indians had respected the Indian use of Boat Harbour through the years and that Indians from other reserves come to fish there certain times of the year.

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The matter of the Pictou Landing dump was discussed in that this dump is situated on the other side of the reserve from the community, and it is creating a nuisance. There are many rats in the vicinity along with smoke which blows on the reserve.

Five main reasons were advanced by the Indians as to why they were not willing to let Boat Harbour be used by the Water Authority without giving strenous objections. (1) Loss of fishing on the Harbour. While no commercial value can be put on it. One spokesman said it is worth $25,000. a year and maybe more. This was made up of $15,000. for food and $10,000. for recreation, sports, pleasure, etc. (2) The use of the Harbour would mean that the Indians from Pictou Landing could not moor their boats in the Harbour and use them for fishing on the bay. (3) There would be a loss to the people on the reserve of game birds, such as geese, ducks, etc. because of feeding would be changed and they would go elsewhere. (4) Loss of swimming recreation area for the children. (5) It would change the pattern of the reserve in that future building sites on that end of the reserve would be spoiled.

Most of the discussion was carried on by Jim Francis and John Prosper. They believe that strong protest from the Indians all over N.S. would be heard and they wish to engage a lawyer very shortly.

At the end of the meeting, Mr. Wigglesworth asked if they would withhold any publicity until the Water Authority could study the matter further, but the Indians gave no assurance that this would be done. Mr. Clench will be preparing a submission to this office immediately.

W.A. McDonald,
Regional Development Officer.

c.c. Shubenacadie Indian Agency

PHONE 752-6131

DR. J. B MACDONALD
DR. J. F. HAMM

FOORD STREET
STELLARTON, NOVA SCOTIA

March 19, 1966

Hon. R. L. Stanfield
Premier of Nova Scotia
Halifax, N. S.

Dear Mr. Stanfield:

I assure you, sir, that I had no wish to prolong this correspondence, except that unfortunately, our letters crossed and since your letter has disturbed me more than any previous correspondence that I have had on the subject, I feel obliged to reply.

You began by assuring me that you did not regard any man as infallible. Then, you indicated almost immediately, that because Dr. Bates had decided the fate of Boat Harbor, that no further thought on the matter was necessary.

In the light of this, I would ask your scrutiny of this type of reasoning which I am about to discuss.

The Water Authority, presumably Dr. Bates, has now said that the damming of Boat Harbor will improve it. Boat Harbor, at present, is used for boating, swimming, fishing, water skiing. The Water Authority states that damming it will make a beautiful fresh water lake which can be used for every one of these things except fishing and swimming. This is exactly like taking a man who has two good legs and removing one--and then saying to him, "You are much better off with one. It will be less bother and you can do everything except, (1) walk well and (2) all those other pursuits that require two legs.

This claim of theirs--that Boat Harbor will be improved by damming--would be much more reasonable if they were going to dam Boat Harbor and then use it for the storage and propagation of sharks. The presence of sharks would only be a relative contraindication to the use of the place for swimming and fishing. Its use for the effluent is an absolute contraindication. Venturesome sportsmen, it seems, do much swimming and skin diving in shark infested waters.

To mention the idea put forth by Mr. Wigglesworth--that a skidway into this lake would be erected--this is like consoling someone for the loss of their parking lot by saying, "Never mind we are erecting a flat topped building on it, just as large as the lot, with a ramp up to it for your car, but just one thing, remember, the roof is covered with soft tar and you won't be able to get out of your car.

DR. J. B MACDONALD
DR. J. F. HAMM

FOORD STREET
STELLARTON, NOVA SCOTIA

My point, sir, I believe is obvious. It may be quite all right to attribute great intelligence and fame to one man, but this should not necessarily denote complete loss of intelligence by others.

From the first, we have only asked that justice and reason prevail, and to date, we cannot assure ourselves that we are getting either.

In closing, I feel compelled to say that if this project goes through, with no further explanation, or justification, or revelation of alternatives, then, let us be frank and say that it has gone through because no one has demonstrated the legal right to stop you. Do not, I beg you, justify it by such claims as discussed in the first of this letter.

Yours sincerely,

Joseph B MacDonald

A.L.

MEMORANDUM

CLASSIFICATION

TO / A: Administrator of Lands,
Indian Affairs Branch,
Ottawa, Ont.

YOUR FILE No. / Votre dossier: 51/8-17

OUR FILE No. / Notre dossier: 51/8-17

DATE: 14 Sept. 1965

FROM / De: The Superintendent,
Shubenacadie, N.S.

SUBJECT / Sujet: Proposed use of Boat Harbour Pictou County for waste water treatment.

I refer to copy of your letter of July 9th 1965 to MRO and their reply of July 15 concerning the above proposal, also MRO letter of August 16th (copy of which you have) to this office.

The meeting referred to in MRO letter was arranged and held on August 25th and a report was submitted to MRO on August 26th.

Todate nothing has been heard as to what stand our Branch might be taking on this proposal of the Nova Scotia Water authority.

As the Indian people are really concerned I am taking the liberty of sending our diary copy of report submitted to M.R.C. directly to your office as due to courses and vacations etc. at MRO. there may have been some delay in submitting the report to you. If you have it already kindly return the enclosed indicating your feelings and recommendations as to what should be done about the controversial project concerning Boat Harbour.

I might add that since the meeting, earlier this month, Mr. Wigglesworth, Chairman of the Water authority came to this office to see if we had heard anything yet. He indicated that a sizable amount could be forthcoming as compensation if the Indian people could be bought off that way - as a feeler he said say $35,000 or possibly much more.

However, money is not of great concern to the Indians. They want their way of life and we have it on good authority

AL 20-9-65

CGSB—6GP22a PP&S Cat. No. 3590

that they are not interested in putting a large sum in their Ottawa Trust account and being allowed to use the interest on it only. Possibly if they were to receive a per capita cash payment of two or three hundred dollars they would make a quick settlement and have a good spending spree - but this would be sad - anyway the proposal of Mr. Wigglesworth was not passed on to the Board as the stand of the Branch is awaited.

In conclusion I would like to point out that there is a possible alternate bay much closed to the Abercrombie Mill than Boat Harbour and that place is Beeg Gut, at least two miles closer. It is possibly one third the size of their choice but could be developed if they had to. This is away from Indian land and would not affect more than the properties of several non Indians with practically no flooding. I was told by Mr. Wigglesworth that they had not considered this place. It should be looked into as an alternate disposal area.

S.G. Clench,
Superintendent,
Shubenacadie Indian Agency.

cc M.H.C.

4-7

MEMORANDUM

CLASSIFICATION

Regional Director, Maritimes.

YOUR FILE No. Votre dossier

OUR FILE No. Notre dossier 51/8-17 (AL)

DATE

October 14, 1965.

Administrator of Lands.

Proposed Use of Boat Harbour, Pictou County, for Waste Water Treatment.

Mr. A. F. Wigglesworth, General Manager, Nova Scotia Water Authority, met with Mr. D'Astous and the writer today, concerning the proposal to use Boat Harbour for waste water disposal. As a result of the meeting, we have a clearer and more detailed appreciation of what is involved.

The possibility of disposing of effluent that will be discharged from the Kraft Mill to be built by Scott Paper Company at Abercrombie Point without utilizing Boat Harbour was discussed. The effluent could be discharged into Pictou Harbour but this would deposit waste material along the shoreline and the effluent would pollute the water. Use of a body of water on the east side of the East River known as Big Gutt has been considered but is said to be too small to handle the volume of effluent that will be discharged from the Mill. All factors considered, the scheme to use Boat Harbour seems to be the best. I may say this is the opinion of Mr. Crapper of the Engineering and Construction Division.

He intends to consult with the appropriate people having knowledge of the type of effluents coming from a Kraft Mill, its chemical composition and volume. Technical advice on these points will assist in determining the likelyhood of the scheme creating a nuisance.

At the meeting on August 25, the Indians indicated opposition to the use of Boat Harbour. Last weekend Mr. Wigglesworth took Chief Francis and Councillor Martine Sapier to inspect a domestic sewage disposal lagoon at Renforth, N. B. This installation is similar to the installation proposed at Boat Harbour. Seeing the lagoon at Renforth provided the Chief and Councillor Sapier with an appreciation and understanding of this type of installation and Mr. Wigglesworth reports they were impressed by the fact that there was not disagreeable odour. On the morning of October 10 the attached paper was prepared by Mr. Wigglesworth in consultation with the Chief and Mr. Sapier and signed by the latter. The five points to be negotiated were reviewed with Mr. Wigglesworth.

1. As regards compensation, Mr. Wigglesworth is of the opinion that a significant loss to the Indians will be with respect to fishing and recreation. I am inclined to think this is a fair statement. It is

difficult to evaluate these rights. It had been suggested to Mr. Wigglesworth by the Chief that the value of the actual catch of the fish would be somewhere between $2,500 and $3,000. On this basis, and allowing a return of 6%, Mr. Wigglesworth proposed a lump sum payment of $50,000. We pointed out to him that the rate of interest allowed on Band Funds is 5% and in proposing the figure to the Indians he should base it on the highest estimate of the annual value of the catch. This seemed to be acceptable to him and I believe he will propose a lump sum payment of $60,000. This is not necessarily an adequate payment but it appears there is little information available on which to base a valuation. You may have some thoughts on this point. In any event, Mr. Wigglesworth was told the Authority would have to be generous with the Indians.

2. A dam will be placed at the entrance to Boat Harbour and the Authority is prepared to provide a skidway to allow boats to be moved around the dam and into the Harbour.

3. Solid material in the effluents will be deposited on land west of the Harbour. Eventually to prevent this material from flowing into the Harbour, a dam or dyke would be required. In order to assure the Indians that this will not happen, the Authority is prepared to build a dam or dyke as part of the initial construction.

4. One plan called for the collection of sewage from upstream communities and depositing of this sewage in the Boat Harbour lagoon. Mr. Wigglesworth said that when and if this sewage project is carried out it is likely Big Gutt will be used for disposal but the Authority would not discharge the sewage at Boat Harbour without prior consultation with the Indians. If an agreement is reached with the Water Authority, one provision could be that use of Boat Harbour will be confined to effluents from the paper mill and effluents from no other source will be discharged without further agreement with the Indians and the Branch.

5. Discharge of the effluents from the mill will be by pipeline but at the moment it is not known whether the pipeline will cross reserve land. The reserve that might be affected by the pipeline would be Boat Harbour West No. 37. If a pipeline easement is needed over this Reserve, it is possible some additional payment could be negotiated. The pipeline will be buried and the surface of the land restored so that I do not think the Indians could expect a substantial payment for an easement should it be required.

At present, Mr. Wigglesworth thinks Boat Harbour will be useful for boating and it is possible that fresh-water fish can be introduced. It is unlikely, however, that the water will be useful for swimming. If present expectations are met, Boat Harbour may not become a dead loss to the Indians.

I gather from Mr. Wigglesworth that some commercial fishing is done by a few Indians but their operations are carried out from the vicinity of Moodie Cove.

Also that this is the best area for swimming by reason of sand beached whereas the bottom of Boat Harbour, I am given to understand, is mud. These are facts which will be within your knowledge.

The Authority is anxious to move ahead with the project and Mr. Wigglesworth wished to know what the next move should be. He was advised to prepare and submit the proposal in writing to the Chief and Council with copies to yourself and Mr. Clench. When this proposal has been received, it should be presented to the Band at large for consideration. Mr. Wigglesworth will be asking you to arrange a Band meeting which he is prepared to attend if his presence is requested. I believe you should be at that meeting also.

I should welcome your views and thoughts on the proposal, especially as to whether it will be disadvantageous to the Indians.

The possibility of employment for Indians at Scott Mill was mentioned to Mr. Wigglesworth and he said that Mr. Walter Miller, Vice-President of Scott Paper Company, had informed him that Indians would have equal opportunity with others for work they are capable of doing. Chief Francis is to meet with Mr. Miller. The one point which was not mentioned to Mr. Wigglesworth was Indian employment on pipeline construction and site preparation. This could be pursued with him.

Mr. Clench, in his report of August 26 on the August 25 meeting, mentioned that the Chief believes there is an old treaty giving the Micmac people exclusive fishing rights in Boat Harbour. Mr. Hugh Conn who has a wide knowledge of such matters was consulted and the only document to which he could refer me is a proclamation by the Lieutenant Governor of Nova Scotia of May 4, 1762. Copies of this proclamation are attached with a letter transmitting the proclamation to London. The important question with respect to the proclamation is the effect it had in 1762 and the effect it has, if any, at the present time. These are difficult questions to answer and I must confess we are not prepared to answer them at the moment. Should the Indians reach an acceptable agreement with the Nova Scotia Water Authority, an answer to the question insofar as Boat Harbour is concerned, will be purely academic.

W. P. McIntyre.

cc: Superintendent, Shubenacadie Indian Agency.

1965
10 October 1965
St. John, N.B.

We the undersigned, speaking for our band at Fisher's Grant in Pictou County, Nova Scotia agree in principle to the use of Boat Harbour as a lagoon for the reception and treatment of pla. effluent from the Scott Paper Co. of Abercrombie Point. This decision has been reached as we feel that it is in the best interests of the entire area.

This is an agreement in principle only and the following points are to be resolved by further negotiation:-

1. Compensation for loss of fishing rights and recreation privileges in Boat Harbour
2. Provision of Skidway
3. Provision of a dam or obstruction at channel at upper end of Boat Harbour
4. At the proper time, and when it is projected to direct Hunan Sewage from New Glasgow-Stellarton, [illegible] are to be [illegible]

2.

2. It is also agreed that right of way will be granted if necessary over Indian lands.

Chief

Witness To Signatures:

Councillor

60 501 3 OCT 25 65

MEMORANDUM

CLASSIFICATION

TO A: Regional Director, Maritimes

YOUR FILE No. Votre dossier:

OUR FILE No. Notre dossier: 51/8-17

FROM De: Superintendent
Shubenacadie Indian Agency

DATE: Oct. 22, 1965.

SUBJECT Sujet: B.C.R. from Pictou Landing
Consenting to use of Boat Harbour
as Waste Water disposal area.

I have today handed Mr. A. F. Wigglesworth in person a certified duplicate copy of a B.C. R. from Pictou Landing Council agreeing to the offer of $60,000.00 made by the Nova Scotia Water Authority for permanent use of Boat Harbour as a waste water treatment area for the Scott Paper Company at Abercrombie Point.

The price offered and terms indicated are quite acceptable to all the Band members and it just remains with our Branch Headquarters to finalize matters as to legal documentation and add any further protective conditions that we may possibly have overlooked.

You will recall that this Resolution was read to you over the telephone yesterday, at which time I advised that Mr. Wigglesworth would be calling in person for a copy of the signed document to take to Ottawa, in order to try and finalize matters with our Branch. You indicated your approval in order not to delay matters.

I am attaching the original Resolution and 3rd, 4th and 5th copies for your recommendation and furtherance to Branch without delay as Mr. Wigglesworth will be in Ottawa October 25th to 27th and your comments should be available.

There is one specific request from the Council of the Band that they wish to be assured of - that is, that a sum of $5,000.00 will be made available to them for renovation and repairs to their Church at Merogomish. This has nothing to do with the Water Authority or affect settlement in any way but I wish it to go on record, as the Band has a feeling that this would not be forthcoming if it is once put into Capital account. I assured them otherwise but they were not convinced. This money would not be required before Spring in any case, so it would be earning interest in the current year.

...2 X

GSB—60922-1 PP&S Cat. No. 3590

Please do all possible to have an early settlement made with the Water Authority as the Band would like to draw up a Budget and get a few things going on the Reserve with their anticipated new and sudden riches.

This has been a hurry-up run around job and I hope that all will be found passably in order.

B. G. Clench
Superintendent

BGC/vm

PRIVY COUNCIL

AT THE GOVERNMENT HOUSE AT OTTAWA

FRIDAY, the 2nd day of SEPTEMBER, 1966

PRESENT:

HIS EXCELLENCY

THE GOVERNOR GENERAL IN COUNCIL.

His Excellency the Governor General in Council on the recommendation of the Minister of Northern Affairs and National Resources, pursuant to section 35 of the Indian Act, is pleased hereby to authorize the transfer to Her Majesty in right of the Province of Nova Scotia, of riparian rights in Boat Harbour in the County of Pictou, Province of Nova Scotia, subject to the terms and conditions set out in the Schedule hereto.

APPROVED

[signature]

CLERK OF THE PRIVY COUNCIL

P.C. 1986-1869

SCHEDULE

Conditions of transfer of administration and control of riparian rights in Boat Harbour, Pictou County, Nova Scotia abutting Fisheries Grant Indian Reserve Number 24 and Fisheries Creek Indian Reserve Number 24C.

The Province of Nova Scotia to compensate the Pictou Landing Band of Indians for the transfer of riparian rights as follows:

(a) to pay $60,000 to the Receiver General of Canada for the use and benefit of the Band;

(b) to provide a skidway for boats for the use of the Band if such skidway is requested by the Band;

(c) to provide a dam on the channel at the upper end of Boat Harbour;

(d) to take remedial action should a septic condition detrimental to the Pictou Landing Band develop in Boat Harbour;

(e) when and if it is decided by the Province to direct human sewage into Boat Harbour, the Province will compensate the Band for any damage or loss which may be suffered by it as the result of the direction of human sewage.

J. B. MacDONALD, M.D.
J. F. HAMM, M.D.
STELLARTON, NOVA SCOTIA

March 22, 1970

To Rust and Associates Consulting Engineers

Sirs:

You have invited representations concerning the area of your involvement as consultants to the Nova Scotia Government "in the matter of pollution control adequacy in the Boat Harbor area".

Two announcements appeared in the New Glasgow Evening News, the first on Thursday, March 20, 1970, which was in the nature of a news flash. The second was on Friday, March 21, and this was evidently a paid advertisement, placed either by your company or the Nova Scotia Government or the Nova Scotia Waters Resources Commission. A photostatic copy of each is attached on the next page.

Please allow me to draw attention to the fact that in neither announcement did the terms of reference of your duties appear. The first announcement designates the problem as the "Scott Maritime-Boat Harbor situation". The second refers to the problem as "the matter of pollution control facilities at Boat Harbor".

Since the first designation appears to me to be more appropriate to the actual problem I prefer to consider the problem as the Scott Maritime-Boat Harbor situation, and therefore begin my comments which are factual, directly at the Scott Maritime plant at Abercrombie.

Firstly, the Scott Mill must be considered a new mill. Operations only started in the late summer of 1967.

Secondly, effluent toilletic at the new Scott plant is inefficient and inadequate as judged by present day standards. Robert M. Fowler, president

of Canada's Pulp and Paper Association has been quoted quite frequently in the Canadian Press this year and I enclose a photostatic copy of one of his shorter quotes--to the effect that anti-collution measures now introduced in new mills are capable of eliminating practically all harmful and unpleasant waste material. This was contained in the Winnipeg Free Press, February 7, 1970.

Thirdly, not all the Scott effluent waste material is even reaching the so called treatment lagoons at Boat Harbor. Trips by boat over the pipeline area reveal constant bubbling, indicating leaks in this pipeline, and this effluent is polluting Pictou Harbor and has caused lobster pound loss to Mr. Campbell MacKay at the area of Pictou Landing referred to as Fairview.

The Ontario Waters Resources Commission,,801 Bay St. Toronto, Ontario, in one of their booklets on water management in Ontario(this particular booklet is called Industrial Pollution Control in Municipalities) state "the high temperatures of industrial effluents may accelerate corrosion, place thermal stresses on piping material, and adversely affect jointing material". This has obviously happened in the pipeline across the East River and this corrosion is very evident also on the concrete sluices after the effluent reaches the first lagoon.

Fourthly, the lagoons are very rapidly filling and the first and second appear to have reached three quarters of their capacity in two years and a few months, which would indicate that without dredging they will be overflowing and useless in less than a year.

Fifthly, The foul odor from the lagoons indicates that they are "dead"- that no oxygen is available to carry out necessary degrading. Mr. R. M. Billings of Neenah, Wisconsin, then vice-president of the Kimberley-Clark

Corporation advised Dr. John Bates in 1965-66 that this could happen and said that if it did, that the addition of 1:1,000,000 parts of oxygen would largely correct this malodorous condition. Mr. Armand Wigglesworth, then chairman of the Nova Scotia Water Authority definitely undertook to have aerators installed. This committment on his part was made at a meeting of a citizens Committee, at the Federal Building, New Glasgow in February, 1966. The Chairman of what is now called the Nova Scotia Water Resources Commission, at a meeting of citizens, at Pictou Landing in the autumn of 1966, Mr. E. L. Rowe, disclaimed any responsibility whatsoever, for any previous committments made by Mr. Wigglesworth and stated the aerators would not be installed because he said it would cost too much money, and to quote himself "he was a cost man". To date no attempt has been made to add oxygen. We more than agree with Mr. Rowe that he is a "cost man". He has cost our county a great deal.

Sixthly, the effluent is not being detained in Boat Harbor for the projected forty-one days. Tests have shown that some effluent entering Boat Harbor can appear in the receiving waters of the Northumberland Strait in as short a space as eight days.

Seventhly, the effluent reaching the Northumberland Strait-22,000,000 gallons approximately daily(minus what goes out the transriver pipeline into Pictou Harbor) is excessive in chemical, color, and solid content. Since resumption of the mill operations following the recent strike, the color index, on one occasion was found to be three times its usual index. I have heard many query the thoroughness of an investigation carried out at a time when the mill was not always in operation and weather conditions and ice might not make for optimal investigation.

Eighthly, the effluent discharged into the receiving waters outside Boat Harbor, in other words, into Northumberland Strait pollutes it. I cannot see how this can be refuted and I quote the definition of pollution as given in the Nova Scotia Water Act and Regulations, Chapter 312, Revised Statutes of Nova Scotia 1954 and amended in 1955-62-63-65.—6 7 .

"Pollution means any alteration of the physical, chemical, biological, or aesthetic properties of the waters of the province, including changes of the temperature, taste or odor of the waters or the addition of any liquid, solid, radioactives, gaseous, or other substances to the waters, or the removal of such substances which will render or is likely to render the waters harmful to the public health, safety, or welfare or less useful for domestic, municipal, industrial recreational, or other lawful uses, or for animals, birds, or aquatic life."

The effluent discharged from the Boat Harbor lagoons into the receiving waters of the Northumberland Strait have, without any doubt, whatsoever, rendered several summer homes completely useless as recreational facilities, including swimming and fishing. This effluent has rendered many more useless as recreational facilities for as much as five days a week in the summer season. The effluent has driven the aquatic life further and further out to sea. Gases from the effluent (and from the stacks) have removed or discolored paint on many houses and have interfered with the full right of owners or occupants "to enter into and enjoy" their homes. The nearby beaches, including Lighthouse Beach, have and are being spoiled. There is evidence that the area of this despoilation is spreading and effects have been felt as far away as Malmerby Beach, eight miles from the lagoon.

In the report of the Nova Scotia Water Resources Commission for 1969, given under the hand of the Minister Donald R. MacLeod, and presumably written by E. L. L. Rowe, (a photostatic copy of page is enclosed with the pertinent paragraphs marked) Mr. Rowe has the temerity to say he has eliminated the foam problem. Unqualified, this is not true. It has reduced the foam where the effluent first meets the receiving waters- but with some conditions of weather and turbulence this foam forms beyond this point and is washed up onto beaches. I don't think it is necessary here to comment on the statement that odor at the discharging lagoon is minimal. This is obviously untrue.

As a physician I have been asked to comment on the Public Health aspects of the situation and I will say this: The lagoons are contributors to what are at times alarming concentrations of sulphur dioxide in some areas of our county. It has been recently stated by medical authorities, after research, that when the concentrations of SO_2 over New York reaches a figure greater than .2 parts per million that 10-20 deaths will occur, attributed to this. Higher concentrations than the above have been observed in some county areas. As regards the malodorous H_2S-it is quite likely that people existing in the lagoon areas and close by habitation, subjected to the concentrations of this gas for long periods, will suffer increased morbidity. Calamities involving many deaths have happened in other countries where, accidentally, large quantities of H_2S have escaped.

It has been observed by all in the area that there has been a remarkable change in the insect life since the mill started operations-there are flying insects and mosquitoes by the millions. While driving at night

on the roads at Pictou Landing ones vision can be virtually interfered with by the myriad insects.

Secondly, as regards public health hazards from the effluent--it is not conceivable that any humans, except small children or mentally retarded ones, would deliberately go into the water when it is at its blackest. (I refer to the waters of the outside beaches, not the lagoons). Should such mentioned, however, ever get into trouble in such waters, rescue would not be possible. Objects cannot be seen at all beneath the surface.

I do not believe there is any knowledge as to what the ingestion of large amounts of this black effluent would do to a child's gastric or pulmonary tissue. I shudder to think of it. Externally, numerous cases of dermatitis have occurred when children have gone into water when discoloring had not been great.

Finally I feel compelled to make a few general remarks before closing. These I believe are pertinent to your consultation or investigation.

We are grateful to the Premier for taking cognizance of our difficulties and complaints and appreciate the fact that following his first real briefing on the problem he promised and instituted an independent enquiry.

We do rather lament the fact, however, that failure on the part of the Chairman of the Nova Scotia Water Resources Commission (and also on the part of the Minister under whom the commission is administered) to admit and perhaps to recognize that a problem existed, has cost the citizen's committee several thousand dollars* and uncounted hours of our time. In addition, of course, as previously mentioned there has been the loss of many many more thousands to some, in devaluation of real estate. This

* one item of which — is $11,500 the "statement" of which is herewith enclosed.

applies both to summer and to permanent residents.

Moreover in spite of the fact that it is obvious to most everyone that a real problem exists, the aforementioned two gentlemen have continued to assert their satisfaction with the situation as it now exists and appear to take it for granted that they will be backed up in this by the consultants. In the light of what can readily be seen by ordinary discerning people- we believe that this is rather insulting to the integrity of the consulting firm of engineers, to continue this attitude during the investigation.

Our committee refuses to countenance any suggestions we have heard to the effect that a consulting firm of engineers, which is referred to in the paper as the pulp and paper engineering firm, may find it difficult to be objective and impartial, since it may depend largely on the pulp and paper industry for a large part of its work. We do not believe that a reputable firm such as yours would give anything less than a completely objective and impartial decision and recommendations.

Respectfully submitted,

J. B. MacDonald, M. D.

P. S. Since the writing of this submission, an article has appeared in the Evening News, March 24, 1970 (photostatic copy enclosed). In the light of this frank revelation, we must conclude that Mr. E.L.L. Rowe, who has always maintained very close contact with Scott Paper, must have had knowledge of these omissions, and has therefore been derelict in his duty to the Nova Scotia Government and to its people. The same would appear to apply to ~~Mr. Elmer Miller, General Manager of~~ Scott Maritime. We must concede, however, that Hon. Donald R. Macleod could have been completely unaware of this situation as he has more than once said in public that Mr. Rowe is his teacher.

IN THE MATTER OF

POLLUTION CONTROL FACILITIES

AT BOAT HARBOR

The Company of Rust Associates, Consulting Engineers, will receive representations on

Wednesday, March 25, 1970

between the hours of 10 a.m. and 5 p.m.

at the Norfolk Hotel in New Glasgow

Rust And Associates To Hold Public Hearing

HALIFAX — Rust and Associates, the pulp and paper engineering firm investigating the Scott Maritimes - Boat Harbor situation, will hold their public hearing in the Norfolk Hotel on March 25, E. L. L. Rowe of Nova Scotia Water Resources Commission confirmed here today.

Mr. Rowe said in a telephone interview staff members of the Montreal engineering consultants will be here to receive briefs or representations from any interested in presenting them.

"We'd prefer them to be in writing so the facts contained can be studied later by their expert staff. However, they'll have a tape recorder with them so statements can be taken and transcripts made."

Mr. Rowe added the Rust staffers would not be answering questions.

"They'll be here to listen. As engineers they are interested in facts and this is considered a part of their fact finding expedition. They are not interested in debating."

Mr. Rowe said he intended to be present but he would be sitting in purely as an observer since the firm had been engaged directly by the Nova Scotia Government to make an independent appraisal of the whole problem.

(At the time it was announced the firm would also be evaluating the report prepared by Delaney and Associates for the group of private citizens banded together as the Northumberland Strait Pollution Control Committee).

The hearing at the Norfolk will sit from 10 a.m. to five o'clock to give all interested the opportunity of making representation.

PULP INDUSTRY TALKS POLLUTION AND PRODUCTION

MONTREAL: World demand for pulp and paper doubles every 10 years according to world industry officials.

The head of Canada's pulp and paper association Robert Fowler said production of 31 million tons after the Second World War had increased sharply to 112 million tons in 1968 and is expected to reach 205 million metric tons by 1980.

In Canada, Mr. Fowler said, the capacity can still be increased substantially.

He declared the Canadian industry has increased pollution control efforts and had reduced the amount of suspended wastes in the country's streams to 21 per cent of what escaped 8 or 10 years ago.

Anti-pollution measures introduced in new mills are capable of eliminating "practically all harmful and unpleasant waste material" he said. FREE PRESS

Item 23

Brief:

To:-
The Company of Rust Associates,
Consulting Engineers.

Sirs:

The following is respectfully submitted on behalf of the permanent and summer residents of Pictou Landing also those who reside near this area.

Boat Harbour is located at Pictou Landing and this area receives more than their share of this pollution.

Reasons why this pollution should be cleaned up and also controlled and history leading to this pollution.

1. When Scott Maritime Pulp Ltd decided to locate at Abercrombie the Nova Scotia Water Authority told the Pulp Co. that they would be responsible for the piping of the effluent from the mill across the East River to Pictou Landing at Boat Harbour, also the building of the two dams in Boat Harbour as part of their pollution set up.

Mr W. C. Mills, Vice President and General Manager of Scott Maritime Pulp Ltd told me personally that the company had nothing to do with the effluent after it left the mill.

2. Property owners of land around Boat Harbour whose land was to be expropriated were not notified in any way, notification should have come by registered mail, we were

made known of the facts when it was found that a map was recorded in the Records Office, Pictou, showing the land taken.

3. Meetings were held at Pictou Landing beginning in 1965 These meetings were largely attended and the Chairman of Nova Scotia Water Authority attended these meetings also other speakers.

4. It appears we were not told correct facts at these meetings. First we were told that there would be no air pollution from the mill, that we would have no polluted water in Boat Harbour, next was that the water running out of Boat Harbour would not harm the bathing beaches outside the harbour, and anyone can see what has happened. Then we were told by Mr. A. F. Wigglesworth at that time Chairman of the Water Authority that aerators would be placed in Boat Harbour but Mr. E. L. L. Rowe was appointed the new chairman of the Nova Scotia Water Authority he told at one meeting that no aerators would be put in as the cost would be to high. Next we were told that it would not hurt the Lobster industry but we know the results, then the foam, Boat Harbour was polluting the beaches outside the harbour

5. The owners of property around Boat Harbour were offered only $10.00 an acre, except the Indians of the Reservation were given $60.000. My land borders on the Indian

.. Reservation. I asked Mr Rowe why they were given this amount and he said for fishing rights lost. The people of Pictou Landing, Fluissides, and Trenton also did their fishing here.

6. Pollution was an issue that they tried to make a hush, hush, affair. All that was ever put in the papers was given to them by the Government, Water Authority and Scott Paper all a one sided story.

7. In October 1968 an extension was added at the lower dam to stop the foam this worked out but only in the calm water, when it get to the waters of Northumberland Strait with the rough water the foam was still there.

8. Pictou Landing is in the middle of air pollution, with the winds down the Harbour we get air pollution from Scott Paper then with the winds east we again get pollution this time from Boat Harbour the fumes are really terrible almost unbearable Then we get water pollution coming down the East River from leaks in the pipe across from the Scott Paper Co. to Pictou Landing - Then water pollution from Boat Harbour when the tide is coming up and runs up along the Lighthouse Beach and into Pictou Harbour. This coloured water with foam spoils the swimming on many occasions. Then foam from the end of the pipe line from Scott Paper to Boat Harbour is an open ditch, being left this way is another reason why

the countryside is so badly polluted.

9. Many property owners have had the paint turning black on their home, and then peel off.

10. Then another serious matter from this pollution at Prat Harbour is the plague we have of mosquitoes and flies of various sizes (not house flies). We never had this situation before, only bothered with some mosquitoes. Now it is so severe it is impossible at most times to sit outside on summer evenings. When the doors are opened the the house are filled with these insects. Hordes of these insects cover the windows that it is impossible to see out. Everyone has their basements full of mosquitoes and some are still there in the spring.

All of which is respectfully submitted on behalf of the permanent and summer residents, also those who reside near this area.

Dated at Victor Landing this 24th Day of March, A.D. 1970.

Rev. Henry G. Ferguson
Councillor for Victor Landing

Report To Rust Commission
On Boat Harbour Pollution Problem
Submitted on behalf of the New Glasgow Lions Club by D. J. Chipman

Our club wishes to express their grave concern over the pollution problem as centred in the Boat Harbour area. Our main concern at present rests with the water pollution as indicated by the beaches along the shore including the once great tourist attraction and recreation area of "Lighthouse Beach." This beach and the private beaches of many Pictonians in the New Glasgow area have been desecrated by the outflow of the black effluent from the Boat Harbour treatment facility.

The obvious discoloration of the water and presence of such a vast amount of foreign material is most disturbing. Reliable reports indicate the great effect this has on our fishermen who once were able to take good catches of shell fish in these waters and now find them barren.

-- Add up the toll of damages --

1. the loss of recreational beaches both for local residents and tourists.
2. the effect on the fishing industry
3. the overwhelming stench of the holding ponds which permeates the whole Pictou Landing area.
4. the deplorable environmental conditions imposed on the minority racial group living adjacent to Boat Harbour.
5. the unbelievably heavy swarms of flies which first appeared with the use of Boat Harbour for effluent treatment and which appear to be directly related to the ponds at "Boat Harbour."
6. The adverse effect of this pollution on property values in the Boat Harbour area.

Everyone is in favour of industrial expansion in the area. Consider however, whether the "toll of damages" of the water pollution and also of the air pollution are fair exchanges for the boost in the economy. Even more soul searching is the necessity to pay such a price for such a boost in the economy. I am sure there are workable and acceptable solutions. The question has got to be not ---

CAN WE SOLVE THE PROBLEM?

BUT -- HOW WILL WE SOLVE THE PROBLEM?

The effects of such pollution continue to spread with time. If it is not halted soon all the beaches in this area will be effectively ruined. Consider the consequences of this. What will happen to our growing tourist trade? Where will our children go in summer for recreation? Where will we as individuals go for relaxation and recreation?

When is firm action to be taken to halt this destruction of our natural invironment and to restore our invironment to a position where we can once again enjoy it? Consider the cost of procrastination. Time waits for no man-- The time for action to rectify this problem is

N O W

The urgency of the situation should be obvious.

We urge the "Rust Commission" to recommend to the N. S. Water Authority and the Province of Nova Scotia a solution to this problem which will be effective in solving the problems mentioned above and acceptable to the residents of Pictou County.

D. J. Chipman
New Glasgow Lions Club
Community Betterment Chairman

DEPARTMENT OF NATIONAL HEALTH AND WELFARE

MINISTÈRE DE LA SANTÉ NATIONALE ET DU BIEN-ÊTRE SOCIAL

CANADA

Medical Services

File No: 772 Pictou Landing

Room 439 Ralston Building,
1557 Hollis Street,
Halifax, N. S.

22 December, 1970.

Regional Director,
Indian Affairs Branch,
P. O. Drawer 160,
Amherst, N. S.

Re: Pictou Landing - Boat Harbour

Dear Mr. Greyeyes:

This is in response to the request that we assess conditions in Boat Harbour resulting from effluent discharged therein by Scott (Maritimes) pulp mill at Pictou, Nova Scotia. The specific request was to provide data against which might be assessed the contention of the Union of Nova Scotia Indians that a "septic condition" exists at Boat Harbour.

We explained the difficulty in defining in legal terms "septic condition" and advised that the term usually indicated putrefication in association with excessive oxygen demand by sewage discharged into a body of water: that usually reference is also made to the presence of bacteria. However, since data relating to the oxygen demand of the effluent might be of some value, we undertook to determine this. You will be interested to learn that we have found a definition of a "septic condition" which does not specifically mention bacteria. The definition goes thus: "decomposition of organic or inorganic matter with lack of oxygen". Even so, only the legal definition would be of value in court.

Samples of water at various locations in Boat Harbour were taken in November and December to determine the oxygen demand. Copies of reports on these are attached. The findings indicate a very high demand for oxygen. Also the demand at the outflow is almost one-half that at the inflow and is still very high. Such findings indicate that

.../2

Boat Harbour has lost all of its original characteristics and is now merely a retention pond. The effluent retained contains pollutants undergoing decomposition by oxidation creating a demand for oxygen in excess of that which can be provided by the water in which they are dissolved or suspended.

We have learned from the Department of Fisheries and Forestry that their Resources Development Branch has been monitoring the effectiveness of the pulp mill wastes treatment at Boat Harbour since 1967 and their findings would seem to indicate a progressive concentration of pollutants.

Perhaps reference could be made to Mr. C. T. Ruggles, Chief, Resources Development Branch, Maritimes Region, Department of Fisheries and Forestry if the lawyer for the Union of Nova Scotia Indians wishes detailed reports of their findings.

Yours very truly,

IFM:HEM
Encl.

L. R. HIRTLE, M. D.
Director, Atlantic Region

MacKEIGAN, COX, DOWNIE & MITCHELL
BARRISTERS AND SOLICITORS

P.O. BOX 2380
POWER COMMISSION TOWER
SCOTIA SQUARE
HALIFAX, NOVA SCOTIA

AUG 3 1971

July 30th, 1971

RECEIVED
OFFICE OF THE DEPUTY MINISTER OF JUSTICE
AUG 5 1971

Honourable John N. Turner P.C., Q.C.
Attorney General of Canada
House of Commons
Ottawa 4, Ontario

227604.

Dear Mr. Minister:

We have been engaged by the Union of Nova Scotia Indians to act on their behalf and on behalf of the Pictou Landing Band with reference to the Boat Harbour situation Pictou County, Nova Scotia.

We are advised that there was an agreement authorized by P.C. 1966-1669, and we have had an opportunity to peruse the "agreement". The recitals in the agreement show clearly the Province of Nova Scotia wishes to make use of Boat Harbour and makes reference to the Indians of the Pictou Landing Band, their rights and privileges in relation to the use of Boat Harbour. The agreement provides for transfer of such rights and each item of consideration listed in the agreement specifically refer to the use of Boat Harbour and the riparian rights in Boat Harbour.

Our information is that while the agreement was in fact authorized by the Order in Council referred to it was never executed by or on behalf of the Government

..2/

of Canada. Assuming the agreement to have been signed by the Federal Government it is our opinion that the Province of Nova Scotia is in breach of the agreement and specifically in breach of item D of the schedule to P.C. 1966-1669, and it is also in breach of the contract specifically consideration 4 of the agreement itself.

These provisions read as follows:

(d) "to take remedial action should a septic condition detrimental to the Pictou Landing Band develop in Boat Harbour;"

4. "If a septic condition detrimental to the Pictou Landing Band develops in Boat Harbour, the Province will take remedial action through the Nova Scotia Water Authority."

In the event the agreement was properly signed it is also our opinion there was misrepresentation both by the Federal and Provincial Government as to the anticipated and eventual results.

During the negotiations Mr. A. F. Wigglesworth, General Manager, Nova Scotia Water Authority on October 14th, 1968 indicated that it was expected that Boat Harbour would be useful for boating and "it is possible that fresh-water fish can be introduced."

In addition the Nova Scotia Water Authority took Chief Francis and Councellor Sapier to inspect a domestic sewage disposal lagoon at Renforth, New Brunswick, an installation said to be similar to the installation proposed for Boat Harbour. This trip was arranged in or around

...3/

October 1965 for the purpose of allaying the fears of the Indians about the possibility of disagreeable odour.

We are of the opinion that the Indians themselves cannot take action against the Province of Nova Scotia, Scott Paper Maritime Limited and Canso Chemicals Limited see the case of Rint vs. Dibble Construction Company Limited et al 1934 Ontario Reports 142. The Attorney General of Canada has in the past--see Her Majesty the Queen v. Harry S. Devereaux 1965 S.C.R. 567 and The King v. Weremy 1943 1 DLR 9--taken action under the Indian Act and specifically Section 31.

We believe that your department and the Department of Indian Affairs are fully cognizant of the intolerable situation that exists, and we therefore request that you as Attorney General of Canada commence action for trespass and/or nuisance coupled with a claim for an injunction.

"Separate and apart from the agreement" and the direct consequences of the Boat Harbour lagoon there has been an unauthorized trespass by the intended Defendants over Indian lands for the pipeline leading to the lagoon.

Again separate from the agreement we are advised there has been trespass by flooding of Indian lands (report of J. R. MacAdam March 14, 1969).

..4/

The Union of Nova Scotia Indians quite rightly feel they have exhausted every avenue to alleviate and remove the intolerable conditions which are detrimental to the general well being and health of the Indians and therefore on their behalf we urge that early action be taken by yourself in accordance with the provisions of the Indian Act.

We are as a matter of courtesy sending a copy of this letter to the Honourable Minister of Indian Affairs and the Member of Parliament for Central Nova.

Yours very truly,

Walter E. Goodfellow

Walter E. Goodfellow

WEEG/mt

ATTORNEY GENERAL
NOVA SCOTIA

B3J 2L6
Halifax, N.S.
July 25, 1974

Mr. Steve Aronson
Legal Counsel
Union of Nova Scotia Indians
P. O. Box 961
Sydney, Nova Scotia

Re: Pictou Landing Indian Band

Dear Mr. Aronson:

I have your letter of July 16, 1974 and I would be pleased to meet with you to discuss the claims of the Union of Nova Scotia Indians made on behalf of the Pictou Landing Band. Before setting a date however, I would be pleased if you could, as you have stated, outline the precise nature of the claims made on behalf of the Indians of Pictou Landing. It is our understanding that the payment in November, 1966 of $60,000.00 by this Province to the then Department of Indian Affairs and Northern Development on behalf of the Pictou Indian Band, was to have been in full compensation for any damages arising out of the Boat Harbour Development.

I will await your reply.

Yours very truly,

Allan E. Sullivan

AES/pc

ATTORNEY GENERAL
NOVA SCOTIA

February 12, 1980

Mr. Walter R.E. Goodfellow, Q.C.
Cox, Downie, Nunn & Goodfellow
Suite 800, Barrington Tower
Scotia Square
P.O. Box 2380
Halifax, Nova Scotia B3J 3E5

Dear Mr. Goodfellow:

Following our meeting last Spring, I requested and have now received financial and statistical information with respect to the performance of the Treatment Facility at Boat Harbour. I have also had the benefit of personal observation of the conditions at Boat Harbour.

I am advised that, as a consequence of complaints about the treatment of effluent from Scott Maritimes Pulp Limited, the Province spent $2,480,000 on improvements to the system in 1972 and 1973. The improvements consisted of the supply and installation of an extension of the pipeline, construction of settling ponds and the aeration basin, and the installation of aerators. The expenditure was in addition to the $1,638,000 cost of the original project. I am also advised that the operating costs of the treatment facility are in the area of a quarter of a million dollars annually.

Based on my personal inspection and advice that I have received from senior officials of the Province's Department of Environment, I am satisfied, that with the exception of the colour of the Boat Harbour water, the improvements to the treatment facility represent "state of the art" technology. I am also advised that astronomical sums would be required to effectively resolve the problem of water colour. While I am in sympathy with the unfortunate esthetic effect of the colour problem, I do not consider it to be sufficiently serious to recommend the expenditure of exceedingly large sums of money in an attempt to make the water clear. Again based on my personal observation, it seems that the odor from the aeration basin is negligible. It also seems apparent that a septic condition does not exist.

I enclose a copy of an Order of the Lieutenant Governor of Nova Scotia in Council made the 31st day of December, 1965 and a copy of an

. . ./2

Order of the Governor General in Council dated the 2nd day of September, 1966. These Orders set out the conditions that the Province has agreed to observe with respect to the disposal of effluent from Scott. It appears that the Province has met these conditions.

The Pulp and Paper Effluent Regulations, made under the Fisheries Act of Canada, provide the basis for control of the final effluent which is discharged from the Boat Harbour Treatment Facility. The Regulations make provision for limitations on the discharge of suspended solids and biochemical oxygen demand. These limits are observed continuously. The Treatment Facility is tested on a daily basis and ~~requests~~ Reports are obtained on a monthly basis.

In the past three years (1977-79) the Treatment Facility has at all times, been in compliance with the Federal suspended solids and biological oxygen demand restrictions, based on the monthly averages as reported by Scott.

In the past four years (1975-79) several toxicity tests have been carried out. All tests showed compliance with the Federal toxicity requirements.

I also enclose a copy of a letter dated July 3, 1979 from the Water Polution Branch of Environment Canada. In that letter Environment Canada states that the quality of the effluent from Boat Harbour is equal to or better than that of any kraft mill effluent treatment system in Canada.

It seems to me that the Province has met all conditions for the installation of a satisfactory treatment system and that it cannot be reasonably or realistically expected to do more at Boat Harbour. I regret that the colour problem continues to exist, however there are, unfortunately, but perhaps out of necessity, some side effects to industrial development and progress.

Yours very truly,

Harry W. How

AIR DISPERSION MODELLING STUDY

Stantec

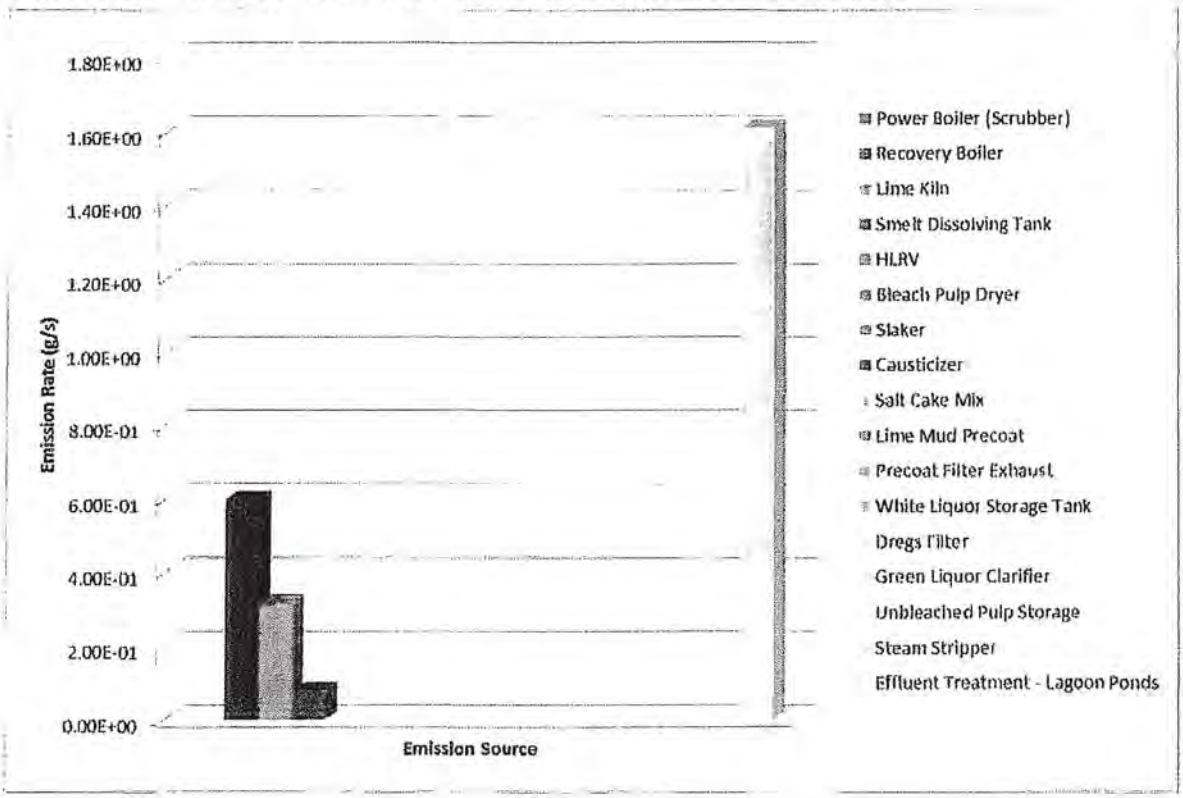
Stantec Consulting Ltd.
102 – 40 Highfield Park Drive
Dartmouth NS B3A 0A3
Tel: (902) 468-7777
Fax: (902) 468-9009

Report Prepared for:

File: 121510960

August 2012

Figure 4.8 Relative Emission Contribution by Source – Mercaptan



5.0 DISCUSSION

As presented in Section 4.3, the following air contaminants have been predicted to exceed the Ontario Standards for either, or both of, the half hour and 24-hour averaging time periods:

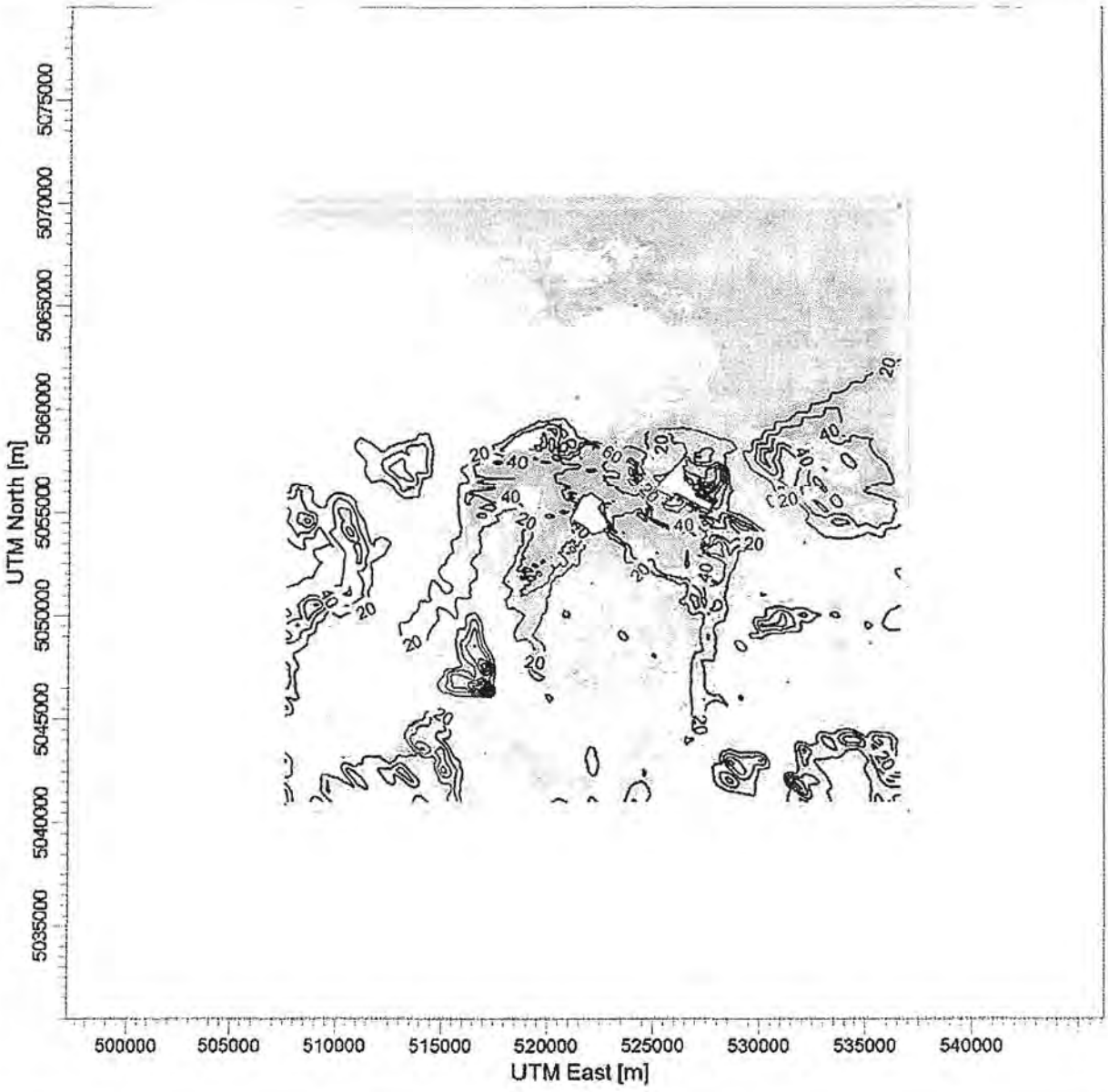
- Acetaldehyde;
- Acrolein;
- Ammonia;
- Chlorine dioxide;
- Dimethyl disulphide;
- Dimethyl sulphide; and
- Mercaptan.

As the dispersion modelling conducted for the above air contaminants was based on published emission factors it is unknown whether or not these exceedances are valid. Northern Pulp is proposing to conduct follow-up source emissions testing prior to finalizing this study for chlorine dioxide. Other contaminants have minor exceedances, as low as one instance in five years, at a concentration of 501 versus a standard of 500; the exceedances are only for the ½ hour, and not for the 24 hour standards. The source emissions testing would be conducted on a select number of sources as per source contribution data and methodology detection level, during the fall of 2012. A source emissions testing pre-test plan will be submitted to Nova Scotia Environment (NSE) for approval at least 30 days prior to the testing taking place. The pre-test plan will outline the sources being proposed for testing and the methodologies that will be implemented. Upon receipt of the source emissions testing results the modelling conducted under this study will be re-done and the report will be revised and issued to NSE as final.

In addition to the above hydrogen sulphide was predicted to exceed the 1-hour and 24-hour Nova Scotia Air Quality Regulations. The modelling conducted for hydrogen sulphide was based on a combination of published data for H_2S (dissolving tank and aerated stabilization basin (ASB) (lagoon ponds)) and source tested data for total reduced sulphur (TRS) (high level roof vent, recovery boiler and lime kiln). As the source emission tested data used in this modelling study for H_2S is, for the most part, TRS and not H_2S the predicted ground level concentrations presented in Section 4.3 would overestimate H_2S.

PROJECT TITLE:

Figure B5 Maximum Predicted 1-Hour Ground Level Concentration of H2S



COMMENTS: Standard = 42 ug/m3	SOURCES: 33	COMPANY NAME: Stantec Consulting Ltd.	
	RECEPTORS: 6359	MODELER: G. Hatcher	Stantec
	OUTPUT TYPE: Concentration	SCALE: 1:308,168 0 10 km	
	MAX: 131.07187 ug/m^3	DATE: 8/31/2012	PROJECT NO.: 121510960

AERMOD View - Lakes Environmental Software

C:\Users\gasche\Desktop\Northern Pulp 2012\hydrogen sulphide\hydrogen sulphide.isc

Science of Odor as a Potential Health Issue

Susan S. Schiffman* and C. M. Williams

ABSTRACT

Historically, unpleasant odors have been considered warning signs or indicators of potential risks to human health but not necessarily direct triggers of health effects. However, citizen complaints to public health agencies suggest that odors may not simply serve as a warning of potential risks but that odor sensations themselves may cause health symptoms. Malodors emitted from large animal production facilities and wastewater treatment plants, for example, elicit complaints of eye, nose, and throat irritation, headache, nausea, diarrhea, hoarseness, sore throat, cough, chest tightness, nasal congestion, palpitations, shortness of breath, stress, drowsiness, and alterations in mood. There are at least three mechanisms by which ambient odors may produce health symptoms. First, symptoms can be induced by exposure to odorants (compounds with odor properties) at levels that also cause irritation or other toxicological effects. That is, irritation—rather than the odor—is the cause of the health symptoms, and odor (the sensation) simply serves as an exposure marker. Second, health symptoms from odorants at nonirritant concentrations can be due to innate (genetically coded) or learned aversions. Third, symptoms may be due to a copollutant (such as endotoxin) that is part of an odorant mixture. Objective biomarkers of health symptoms must be obtained, however, to determine if health complaints constitute health effects. One industry that is receiving much attention, worldwide, related to this subject is concentrated animal production agriculture. Sustainability of this industry will likely necessitate the development of new technologies to mitigate odorous aerial emissions. Examples of such "environmentally superior technologies" (EST) developed under the initiative sponsored through agreements between the Attorney General of North Carolina and Smithfield Foods and Premium Standard Farms are described.

People are exposed to odors every day in crowded buses and restrooms, at petting zoos, or at garbage collection sites. Complaints from brief encounters with these odors tend to focus on their unpleasant quality rather than on health symptoms. Historically, unpleasant odors have been considered warning signs or indicators of potential risks to human health, but not necessarily direct triggers of health effects (Phillips, 1992; Gardner et al., 2000; Persaud et al., 2003). Malodors provide warnings of microbial growth in food, chemical oxidation of lipids (for example, rancidity of oils that hasten the atherogenic process), gas leaks, fires, and unsanitary conditions such as fecal and urinary incontinence (Kalantar et al., 2002; Nakai et al., 1999; Pearce et al., 2003). Medical practitioners have used odor cues from human breath and body fluids to diagnose a variety of diseases. Examples of odorous compounds found in the breath that can be used for diagnosis of medical conditions include: pentane (liver disease; Moscarella et al., 1984), acetone (acute destructive pancreatitis; Zemskov et al., 1992), C2–C5 hydrocarbons (lipid peroxidation; Frank and Durk, 1983; Sedghi et al., 1994), acetaldehyde (alcoholic intoxication; Jones, 1995), dimethyl sulfide (cirrhosis of the liver; Tangerman et al., 1983; Chen et al., 1970), dimethylamine, trimethylamine (uremia; Simenhoff et al., 1977), pyridines (periodontitis; Kostelc et al., 1980), and carbon disulfide (disulfiram/Antibuse therapy; Phillips et al., 1986). Odors from urine (Najarian, 1980), stools (Poulton and Tarlow, 1987; Hausner and Hausnerova, 1979), and vaginal secretions (Majeroni, 1991) have also been shown to have diagnostic value. Characteristic odors in urine have been associated with urinary tract infections (Ditchburn and Ditchburn, 1990), isovaleric acidemia (Burke et al., 1983), phenylketonuria (Burke et al., 1983), maple syrup urine disease (Burke et al., 1983), trimethylaminuria (Burke et al., 1983), *Escherichia coli* (Jenum, 1985), and exposure to cyclohexane vapor (Yasugi et al., 1994). Characteristic smells in stools are clinical features of rotavirus (Poulton and Tarlow, 1987) and urease-negative strains of *Yersinia enterocolitica* (Hausner and Hausnerova, 1979). Vaginal infections are also associated with characteristic odors (Majeroni, 1991; Hillier et al., 1992).

HEATH COMPLAINTS FROM ODOROUS AIR POLLUTION

Recently, there have been increased public health concerns that odors may not simply serve as a warning of potential health risks, but that odor sensations themselves may cause health symptoms. Malodors emitted from smokestacks of large factories, wastewater treatment plants, and large animal production facilities elicit far more citizen complaints than odorless air pollutants such as nitrogen dioxide. In a typical air pollution control district in California, between 70 and 80% of citizen-initiated calls were concerned with environmental odors (Shusterman, 1992). This is due both to their offensive sensory properties as well as the association by the affected individuals of the odors with their health symptoms. Furthermore, retrospective studies indicate that symptom prevalence near polluted sites can increase significantly when the ambient air is odorous (Shusterman et al., 1991). For example, headaches showed an odds ratio of 5.0 when respondents who reported perceiving frequent environmental odors from municipal and sewage industries and petroleum sludge were compared with those reporting no odors. Odors have also been shown to exacerbate chronic respiratory problems such as asthma (Beach et al., 1997; Shim and Williams, 1986; Herbert et al., 1967; Eriksson et al., 1987; Millqvist and Lowhagen, 1996; Subiza et al., 1992; Horesh, 1966). Examples

S.S. Schiffman, Department of Psychiatry, 54212 Woodhall Building, Box 3259, Duke University Medical Center, Durham, NC 27710-3259. C.M. Williams, Department of Poultry Science and Animal and Poultry Waste Management Center (APWMC), North Carolina State University, Raleigh, NC 27695-7608. Received 28 Jan. 2004. *Corresponding author (sss@duke.edu).

Published in J. Environ. Qual. 34:129–138 (2005).

677 S. Segoe Rd., Madison, WI 53711 USA

Table 1. Examples of odor sources in indoor and outdoor air that frequently elicit health complaints (Schiffman, 1998; Shusterman, 1992; Schiffman et al., 2000).

Air	Example
Indoor	Tobacco smoke, ammonia, perfume or cologne, bathroom tile cleaners, bleach, fresh paint, magic marker, nail polish remover, bathroom cleaners, pesticide treatment, mothballs, solvents (for example, turpentine), hair spray, potpourri, animal odors, restroom deodorizer, nail polish, adhesives, bed linens washed with odorous detergents, dry-cleaned clothes, scented candles, gas stove and oven, mold, formaldehyde (from particle board, tobacco smoke), new carpeting, building materials, detergent aisle in grocery store, beauty salon, dry cleaners, garden store, swimming pool, fabric store, motor vehicle body shops, photo-processing stores.
Outdoor	Stationary sources: Confined animal feeding operations (for example, swine and poultry), livestock feed lots, rendering plants, sewage treatment plants, composting and other biomass operations, fertilizer factories, pesticide operations, industrial and hazardous waste sites, storm drain systems, sanitary landfills, paper mills, geothermal steam plants, petroleum refineries, foundries, chemical (plastics, adhesives, solvents), and food (bread, coffee, confectionery, oils) manufacturing factories, tanneries, metalworks.
	Smaller area sources: Fumes from roof and road tar, metal degreasing and painting operations, bakeries, breweries, fresh paint, gasoline, animal odors, burning leaves, molds, pesticide treatment.
	Mobile sources: Diesel exhaust, general traffic exhaust (cars, buses, planes, trucks, trains, construction equipment, lawn mower).
	Naturally occurring sources: Volcanoes, wildfires, wind-blown dust from agricultural fields.

of odors in both indoor and outdoor air that have been reported to elicit health complaints are given in Table 1.

In agricultural communities, health complaints associated with odorous air pollution have escalated dramatically with the proliferation of large-scale animal feeding operations (AFOs) that house thousands of animals at a single facility (Schiffman et al., 2000). The focus of this concern has been potential human health effects for workers and neighbors in adjacent communities who breathe odorous air emissions that emanate from confinement barns (animal houses) and waste storage systems (including multiacre manure lagoons), and during land application of waste (Donham et al., 1977; Schiffman et al., 1995; Thu et al., 1997; Wing and Wolf, 2000). Malodorous aerial emissions from AFOs consist of a mixture of volatile organic compounds (VOCs), hydrogen sulfide, ammonia, and particulates (including bioaerosols) that arise during microbial decomposition of manure (Schiffman et al., 2001; Schiffman, 1998). Occupational studies of workers who care for hogs at AFOs indicate that airway disease is common in this group with progressive decreases in lung function occurring over a period of years (Donham, 1993). Common health complaints among workers at animal production facilities include asthma-like syndrome, exacerbation of preexisting asthma, sinusitis, chronic bronchitis, nasal mucous membrane inflammation, nasal and throat irritation, headaches, and muscle aches and pains (Iowa State University and the University of Iowa Study Group, 2002; Von Essen and Romberger, 2003). Objective measurements of lung function using spirometry have found acute (cross-shift) and chronic respiratory impairment in workers at both swine and poultry feeding operations (Donham et al., 1977, 1986, 2000; Donham, 1993; Schwartz et al., 1992, 1995). Furthermore, acute exposures to elevated levels of hydrogen sulfide from agitated manure (when handling animal waste) can cause reactive airway distress syndrome (RADS), permanent neurological damage, and even death (Schiffman et al., 2001).

Several controlled epidemiological studies in North Carolina and Iowa have shown that health complaints are also elevated in neighbors living in the proximity of swine operations. A field study in Iowa found that a random sample of 18 persons residing within a 3.2-km (2-mile) radius of a 4000-head swine facility experienced significantly higher rates of symptoms associated with respiratory inflammation than a demographically comparable control group of 18 individuals living distant from intensive livestock operations (Thu et al., 1997). Residents of a rural North Carolina community with a 6000-head hog operation (n = 55) reported increased symptoms of headache, runny nose, sore throat, excessive coughing, diarrhea, burning eyes, and reduced quality of life compared with residents in rural communities with intensive cattle operations (n = 50) or without livestock facilities (n = 50) (Wing and Wolf, 2000). In another epidemiological study in North Carolina, neighbors (n = 44) of swine facilities reported significantly more tension, depression, anger, fatigue, and confusion at the time when the odors were present compared with a control group (n = 44) of unexposed persons (Schiffman et al., 1995). Furthermore, a controlled human exposure study has just been completed by the first author of this paper in an environmental chamber designed to simulate exposure to air emissions that could occur at 225 to 300 m downwind from a confined animal feeding operation (CAFO). The exposure levels to swine air were hydrogen sulfide (24 ppb [v/v]), ammonia (817 ppb [v/v]), and odor (57 times above odor threshold). Exposure levels of particulates and endotoxin were very low. The main finding was that headaches, eye irritation, and nausea were significantly higher in the swine air (experimental) condition than in a control (clean air) condition.

MECHANISMS BY WHICH ODORS MAY PRODUCE HEALTH SYMPTOMS

Due to increasing concerns about odorous air pollution, the USEPA and the National Institute on Deafness and Other Communication Disorders (NIDCD) cosponsored a workshop at Duke University in 1998 to assess our current state of knowledge regarding the health effects of ambient odors (see Schiffman et al., 2000). Special emphasis was placed on potential health issues associated with odorous emissions from animal manures and other biosolids. To address this issue, workshop participants defined levels of odor exposure to clarify the intensities associated with potential health effects (see Table 2). Participants concluded that at least three mechanisms exist by which ambient odors may produce health symptoms in communities with odorous manures and biosolids. In Mechanism 1, symptoms can be induced by exposure to odorants (compounds with odor properties) at levels that also cause irritation or other toxicological

effects. That is, irritation—rather than the odor—is the cause of the health symptoms, and odor (the sensation) simply serves as an exposure marker. An example is ammonia with an odor threshold of 0.8 ppm (v/v) and an irritation threshold of 4 to 8 ppm (v/v). At concentrations of 4 to 8 ppm and above, odor is merely coincident with the more relevant irritative process, and health symptoms are more likely caused by irritation rather than "odor-induced." In Mechanism 2, health symptoms can occur at odorant concentrations that are above odor thresholds but are not irritating, which typically occur with exposure to certain odorant classes such as sulfur-containing compounds (for example, hydrogen sulfide, H_2S). The odor threshold for H_2S ranges from 0.5 to 30 ppb (v/v) for 83% of the population while the irritant threshold ranges from 2.5 to 20 ppm (v/v). Six community studies (Jaakkola et al., 1990, 1991; Haahtela et al., 1992; Kilburn and Warshaw, 1995; Legator et al., 2001; Campagna et al., 2000) have reported that exposure to H_2S at nonirritant concentrations is associated with health symptoms. In Mechanism 3, the odorant is part of a mixture that contains a copollutant (such as a pesticide or bacterial endotoxin) that is fundamentally responsible for the reported health symptom. Workshop participants emphasized the importance of using objective biomarkers to determine if health complaints constitute health effects. In addition, participants also concluded that far better technologies for mitigating odor are necessary to reduce any potential health effects.

Evidence for Mechanism 1: Irritation Rather than the Odor Causes the Health Symptoms

To understand Mechanism 1, it is necessary to describe the basics of odor physiology. Odors are sensations that occur when compounds (called odorants) stimulate receptors in the nasal cavity. Odorants can induce sensations in two ways: (i) interaction with odorant receptors in the olfactory epithelium in the top of the nasal cavity and (ii) stimulation of free nerve endings in the nose, throat, and lungs at elevated concentrations. When volatile compounds activate odorant receptors, signals are transmitted via the olfactory nerve (first cranial nerve) to the olfactory bulb and ultimately to the brain. The odor sensations that are induced by this process are described by adjectives such as floral, fruity, earthy, fishy, fecal, and urinous. When odorous compounds also activate free nerve endings in the upper and lower respiratory system (via the trigeminal and vagus nerves respectively), sensations such as irritation, tickling, burning, stinging, scratching, prickling, and itching are induced. For Mechanism 1, irritancy occurs at a concentration above—but within an order of magnitude of—the odor threshold. That is, concentration at which irritancy is first detected is between 3 and 10 times higher than the concentration at which odor is first detected. Examples of odorous compounds in the home or office that become irritants at concentrations somewhat above their odor thresholds include ammonia, chlorine, camphor, menthol, alcohol, and formaldehyde (for example, from building products) as well as acrolein, acetaldehyde, and organic acids (for example, from cigarettes). Thus, at concentrations at or above the irritant threshold, both odor and irritant sensations occur simultaneously. Odor is merely coincident with the more relevant irritative process, and health symptoms are more likely caused by irritation rather than "odor-induced." Odor sensations are simply a warning that potential health symptoms can occur at elevated concentrations.

Sensory irritation can be induced by a single odorous compound above its irritant threshold or by the aggregate effect of low concentrations of compounds (although each individual chemical constituent is below its irritant threshold concentration) (Cometto-Muñiz and Cain, 1992; Cometto-Muñiz et al., 1997, 1999; Korpi et al., 1999). Agonistic effects can even occur when subthreshold concentrations of multiple individual volatile organic compounds (VOCs) combine to produce odor and noticeable sensory irritation. When irritant compounds or mixtures come in contact with the upper and/or lower airway, many systemic responses can occur including: (i) altered respiratory rate, depending on the primary level of irritation (upper versus lower); (ii) reduced respiratory volume; (iii) increased duration of expiration; (iv) contraction of the larynx and bronchi and increased bronchial tone; (v) increased nasal secretion, inflammation, and nasal airflow resistance; (vi) lacrimation or tearing; (vii) alterations in spontaneous body movements; (viii) increased epinephrine secretion; (ix) peripheral vasoconstriction

Table 2. Levels of odor exposure (adapted from Schiffman et al., 2000).

Level	Description
(1) Odor detection	The level of odor that can first be differentiated from ambient air.
(2) Odor recognition	The level of odor at which the odor quality can first be characterized (for example, the level at which a person can first detect that an odor is apple or manure).
(3) Odor annoyance	The level at which a person is annoyed by an odor but does not show or perceive a physical reaction. Note: Health symptoms are not expected at these first three levels unless the odor occurs with a copollutant such as dust as in Mechanism 3 or the level of annoyance is intense or prolonged.
(4) Odor intolerance (causing somatic symptoms)	The level at which an individual may show or perceive physical (somatic) symptoms to an odor. Note: This level corresponds to Mechanism 2 in which the odor induces symptoms even though the odorant concentration is lower than that known to cause irritation.
(5) Perceived irritant	The level at which a person reports irritation or physical symptoms as a result of stimulation of nerve endings in the respiratory tract.
(6) Somatic irritant	The level at which an odorant (not an odor) results in a negative physical reaction regardless of an individual's predisposition. This can occur when an odorous compound (for example, chlorine) damages tissue. Note: Perceived and somatic irritation correspond to Mechanism 1.
(7) Chronic toxicity	The level at which an odorant can result in a long-term health effect.
(8) Acute toxicity	The level at which an immediate toxic effect is experienced (for example, a single event may evoke an acute health effect). Note: In the case of chronic or acute toxicity, the compound should not be considered an odorant but rather a compound with toxic effects that happens to have an odor.

and increased blood pressure; and (x) sneezing (Allison and Powis, 1976; Angell and Daly, 1969; Alarie, 1973; Nielsen, 1991).

Repeated exposure to odorous irritants can induce chronic respiratory disorders including asthma (Andersson et al., 2003; Tarlo and Liss, 2003; Luo et al., 2003; Yang et al., 2003). The potential induction of asthma is of special concern because its prevalence has increased 75% in the entire population (and 160% in children under the age of five) from 1980 to 1994 (Mannino et al., 1998). Asthma prevalence in rural children is comparable with that found in large cities of the U.S. Midwest (Chrischilles et al., 2004). The elevated vulnerability to environmental exposures in young children is due to the fact that they breathe more air per pound of body weight than adults (Etzel, 2003; American Academy of Pediatrics, 1993). Older adults are also vulnerable to air pollution exposures due to age-related impaired function of the lung (Kelly et al., 2003; National Academy of Sciences, 2002). Direct health care costs for asthma in the United States total more than $8.1 billion annually; indirect costs (lost productivity) add another $4.6 billion for a total of $12.7 billion (American Lung Association, 2002).

Evidence for Mechanism 2: Health Symptoms Occur at Odorant Concentrations that Are Not Irritating

Health complaints frequently occur from odorous emissions that are below irritant thresholds, especially when the odor is unpleasant (Schiffman et al., 2000, 2001). An example is the gas H_2S, which smells like "rotten eggs" at low concentrations. The odor threshold for H_2S ranges from 0.5 to 30 ppb (v/v) for 83% of the population while the irritant threshold ranges from 2.5 to 20 ppm (v/v). Thus, the mean odor threshold for H_2S (and other sulfur-containing compounds and organic amines) tends to be three to four orders of magnitude (that is, 10^3 and 10^4 times) below the level that causes irritation or classical toxicological symptoms. Yet six community investigations have found that exposure to low levels of H_2S or other reduced sulfur compounds cause health effects: (i) two studies in communities near paper mills in South Karelia, the southeastern part of Finland (Jaakkola et al., 1990; Haahtela et al., 1992); (ii) northern Finland studies of respiratory infections in children (Jaakkola et al., 1991); (iii) neurobehavioral studies near a refinery (Kilburn and Warshaw, 1995); (iv) studies in Odessa, Texas, and Puna, Hawaii (Legator et al., 2001); and (v) studies near the IBP meat packing plant in Nebraska (Campagna et al., 2000). Furthermore, two of these community studies (Jaakkola et al., 1990; Kilburn and Warshaw, 1995) reported health effects from an average daily exposure to 10 (to 11) ppb H_2S (v/v).

The mechanisms responsible for health complaints to an unpleasant odor in the absence of irritation are not well understood, but several factors appear to be involved. First, humans are genetically coded such that pleasant and unpleasant (for example, H_2S) odors activate different parts of the brain. Noninvasive functional neuroimaging techniques including positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) have shown that there is regional specialization in the brain based on odorant hedonic values (Fulbright et al., 1998; Zald and Pardo, 1997; Birbaumer et al., 1998). Brain structures that are activated by unpleasant experiences are preferentially stimulated when smelling H_2S. Thus, aversion to unpleasant odors for the human species appears to have an evolutionary basis and is hence biologically developmentally driven. That is, there appears to be a biological imperative based on anatomy of the nervous system that alerts humans to avoid certain unpleasant odors associated with potentially unsafe food and air (similar to the gag reflex from tasting something excessively sour or bitter, or the reflex action of withdrawing the hand after accidentally touching something hot). Second, exquisite sensitivity of the nose to hydrogen sulfide gas (H_2S) may be a protective mechanism to prevent dysregulation of normal H_2S metabolism. Hydrogen sulfide gas is produced endogenously during metabolism of sulfur-containing amino acids, and it functions as a neuromodulator in the brain as well as a regulator of the tone in smooth muscle (Kimura, 2000; Hosoki et al., 1997). A small increase in sulfide levels less than twofold greater than endogenous values is lethal (Warenycia et al., 1989). Even small changes in the brain may affect behavior (see Reiffenstein et al., 1992). Third, unpleasant odors can modulate breathing patterns and thus can potentially affect health and well-being. The RD50 values (concentrations that induce a 50% decrease in respiratory rate) for a random sample of unpleasant smelling compounds were much lower than for pleasant smelling compounds (Gift and Foureman, 1998, as reported by Schiffman et al., 2000). Furthermore, if the odors are strong, shallow and irregular breathing can occur due in part to the fact that sniff volume is inversely proportional to the concentration of the odorant (Laing, 1983; Schiffman et al., 2000). Fourth, exposure to malodors may cause or exacerbate illnesses because they impair mood and induce stress. Many studies have shown that unpleasant odors including H_2S impair mood (Ehrlichman and Bastone, 1992; Schiffman et al., 1995; Kilburn and Warshaw, 1995). For example, residents living near large-scale hog operations were found to have increased levels of tension, depression, anger, fatigue, and confusion as measured by the profile of mood states (POMS) when malodors were present (Schiffman et al., 1995). This mood impairment may be due in part to the fact that the exposure to malodor was involuntary. Mood impairment and stress have been associated with development of coronary artery disease, chronic hypertension, and structural changes of the heart in some studies (Karasek et al., 1981; Johnson and Hall, 1988; Schnall et al., 1990). Finally, conditioned or learned associations may play a role in perceptions and health symptoms induced by malodors (Shusterman, 1992; Simon et al., 1990; Dalton and Wysocki, 1996; Karol, 1991). For example, if an unpleasant odor has previously been associated with flu or allergic symptoms, the odor alone may subsequently recreate these symptoms in the absence of flu virus or allergy.

Evidence for Mechanism 3: A Copollutant in an Odorous Mixture Is Responsible for the Reported Health Symptom

Odorant mixtures may contain (i) nonodorous copollutants such as nitrogen dioxide (NO_2) and/or carbon monoxide (CO), (ii) particulates, or (iii) toxicants from mold that are the actual cause of health effects. Odors can arise from incomplete combustion of fuel with oxygen (Schiffman et al., 2000). However, the harmful effects of the combustion may be due to odorless components such as NO_2 and/or CO. Particulate exposure also elevates the incidence of respiratory symptoms and can increase the risk of respiratory and cardiovascular morbidity including increased hospital admissions or emergency room visits for asthma or other respiratory problems. Health effects can begin to occur when ambient particles smaller than a 10 μm fall between 30 and 150 $\mu g\ m^{-3}$ (Committee of the Environmental and Occupational Health Assembly of the American Thoracic Society, 1996). Particulates in indoor air can arise from stoves, fireplaces, chimneys, tobacco smoke, hair, skin, molds, and pollen. Sources of particulates in outdoor air can arise from motor vehicles, industrial facilities, residential wood burning, and outdoor burning. In rural communities, particulates are also emitted from intensive animal operations and include manure, molds, pollen, grains, feathers, endotoxin, and feed dust. A recent study suggests that adverse effects of particulates are augmented by the presence of an odorous compound (Donham and Cumro, 1999).

Sustainable Agriculture Necessitates Mitigation of Odorous Aerial Emissions

One of the main conclusions from the workshop at Duke University sponsored by the USEPA and National Institute on Deafness and Other Communication Disorders (NIDCD) (see above) was that sustainable animal agriculture necessitates the development of technologies for reducing odorous emissions to blunt potential human health effects. During the past decade, trends in animal production agriculture have been toward intensive industrial systems in which less than 10% of the feed for the animals is produced within the production (or farm) unit. While intensive systems are effective at addressing the world's escalating demand for affordable meat products, their effect on both human health and the environment will determine the future of animal agribusiness in many parts of the world. The environmental issues are often geographically specific but, in general, include animal manure management; production-associated consumption of limited water resources; and aerial emissions including ammonia, hydrogen sulfide, methane, nitric oxide, nitrous oxide, volatile organic compounds (VOCs), endotoxins, exotoxins, particulate matter, and odorants (Williams, 2002). Particulates and odor emissions are of particular importance, especially because of the potential effects that these components have on human health (Schiffman et al., 2000).

North Carolina represents a state in the United States in which much activity has occurred over the past decade relative to pork production agriculture and serves as a model for the rapid growth of the industry, associated environmental issues, and efforts to develop new technology to address the issues. Between 1991 and 1997 the swine inventory in the state increased by approximately 300% from 2.7 million head to approximately 10 million head. However, since 1997 the number of facilities and the number of animals has remained stable due, in part, to a state-mandated moratorium on development of new facilities that use traditional waste management treatment processes. Expansion or new facilities can only occur with the implementation of "innovative" or "environmentally superior" technologies.

Technologies for Mitigating Aerial Emissions

In North Carolina a research, development, and demonstration initiative is underway to identify technologies capable of addressing aerial emission concerns and other environmental effects associated with concentrated swine production operations. The initiative is sponsored through agreements between the Attorney General of North Carolina and Smithfield Foods and Premium Standard Farms to develop "environmentally superior technologies" (EST) for implementation onto farms located in North Carolina that are owned by these companies (Williams, 2002, 2003a, 2003b). Swine waste treatment technology development under these agreements includes a covered in-ground anaerobic digester, a sequencing batch reactor, an upflow biological aerated filter system, mesophilic and thermophilic anaerobic digesters, energy recovery systems, greenhouse vegetable production system, solid separations systems, constructed wetlands system, nitrification–denitrification systems, soluble phosphorus removal systems, belt manure removal systems, gasification system to thermally convert dry manure to a combustible gas stream for liquid fuel recovery, ultrasonic plasma resonator system, manure solids conversion to insect biomass for value-added processing into animal feed protein meal and oil system, reciprocating water technology system, and a dewatering–drying–desalinization system.

Technology Descriptions

Descriptions and process flow diagrams for most of these systems have been published elsewhere (Williams, 2002, 2003a, 2003b; Havenstein, 2003). General mechanisms of how these technology processes may reduce odor emissions are enumerated in Table 3. Environmental performance analysis for these technologies includes an integrated program approach in which each is systematically analyzed for emissions of odor (Schiffman et al., 2003). Following are overview summaries for some of the candidate EST technologies in which odor remediation data have been procured to date.

Covered In-Ground Anaerobic Digester and Nitrification Biofilter

This system, located on the Julian Barham Farm in Johnson County, North Carolina, is comprised of an

Table 3. Technology processes that may affect the management of odor emissions.

Odor remediation technology process	Potential mechanism
Covered or enclosed anaerobic digesters	Physical containment during biological anaerobic decomposition.
Nitrification and denitrification	Biological aerobic catabolism of ammonia and organic odorants.
Solids separation (belt and screen systems)	Reduced organic load of liquid manure requiring treatment. Enhanced drying of solids and reduced mixing of manure solids with urine (belt system).
Aerobic biofiltration	Biological catabolism of organic odorants under aerobic conditions.
Phosphorus precipitation	Removal of nutrient (and bacteria) that can contribute to biological production of odorants.
Biosolids gasification	Heat and pressure destruction of bioactive compounds and odorant generating bacteria.
Biosolids combustion	Heat and pressure destruction of bioactive compounds and odorant generating bacteria.
Biosolids conversion to insect biomass	Rapid decomposition of manure biosolids in contained environment.
Semipermeable cover	Reduced dispersion and biological oxidation of odorant compounds.
Wetlands (constructed and reciprocating)	Biological catabolism of organic odorants under aerobic conditions.
Drying and dewatering manure effluent	Reduced liquid medium for biological decomposition.
Disinfection	Reduction in the number of bacteria that produce odorant compounds during microbial decomposition.
Ultrasonic energy and mechanical cavitation	Gas (oxidant), heat, and pressure destruction of bioactive compounds and odorant generating bacteria.

impermeable high-density polyethylene cover over an earthen lined digester that operates under ambient temperature conditions. Liquid manure from approximately 4000 sows housed in six buildings is conveyed to the digester. Biogas that is produced during the anaerobic digestion is extracted and conveyed to a generator where electricity is produced for use on the farm. Treated effluent from the digester flows into a storage pond, some of which is further treated in trickling nitrification biofilters. The nitrified effluent from the biofilters is used to flush the six swine buildings or for fertilization of tomato plants in greenhouses located on the farm. An aerial view of the treatment system is shown in Fig. 1.

Solids Separation and Reciprocating Wetland

This technology is located on the Corbett Farm 2 in Duplin County, North Carolina. The reciprocating wetland component represents a wastewater treatment process developed by the Tennessee Valley Authority's (TVA) Environmental Research Center. The reciprocating wetlands are comprised of two cells (basins), filled with aggregate media, which alternately drain and fill on a recurrent basis. The draining and filling cycles create aerobic, anaerobic, and anoxic conditions within the cells, providing both biotic and abiotic treatment processes to provide nitrification, denitrification, and phosphorus removal. The liquid manure entering the cells is previously processed through a belowground settling tank for solids separation. An aerial view of the treatment system is shown in Fig. 2.

Upflow Biological Aerated Filter System

This technology system, designed and operated by Ekokan LLC, was housed on Murphy-Brown Farm 93, located in Bladen County, North Carolina. The system treated wastewater from five hog buildings containing approximately 800 finishing pigs each. The wastewater was initially processed through a solids separation unit to remove course solids. Subsequently, the wastewater was treated through first- and second-stage aerated up-

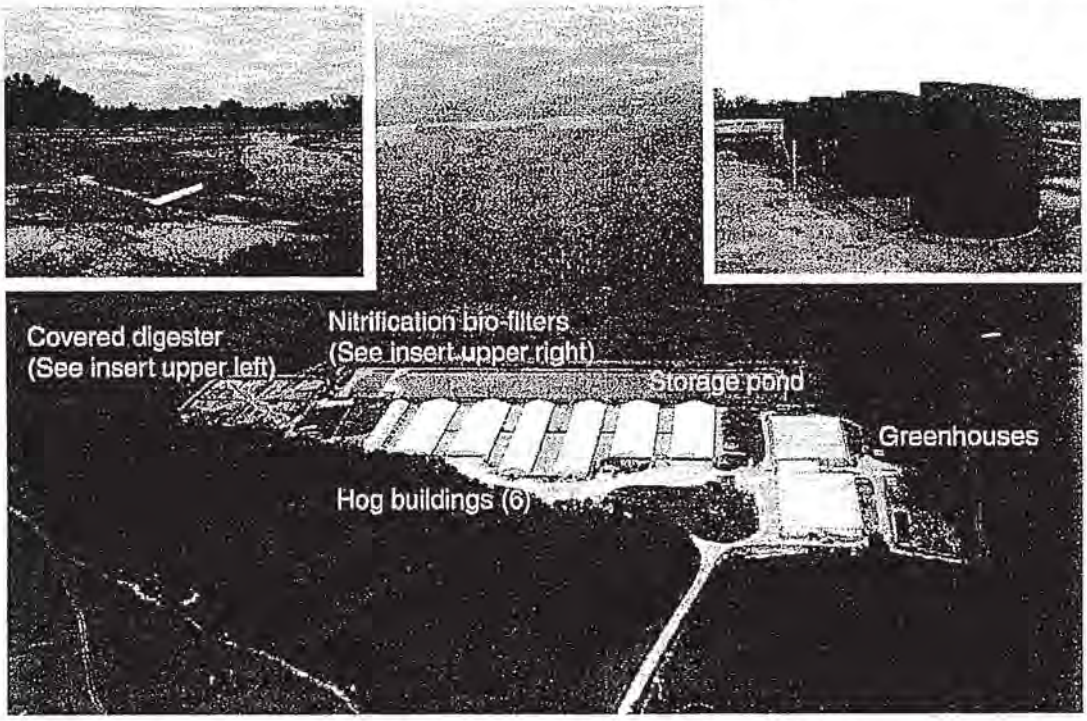


Fig. 1. Aerial view of the ambient temperature covered anaerobic digester and nitrification denitrification system.

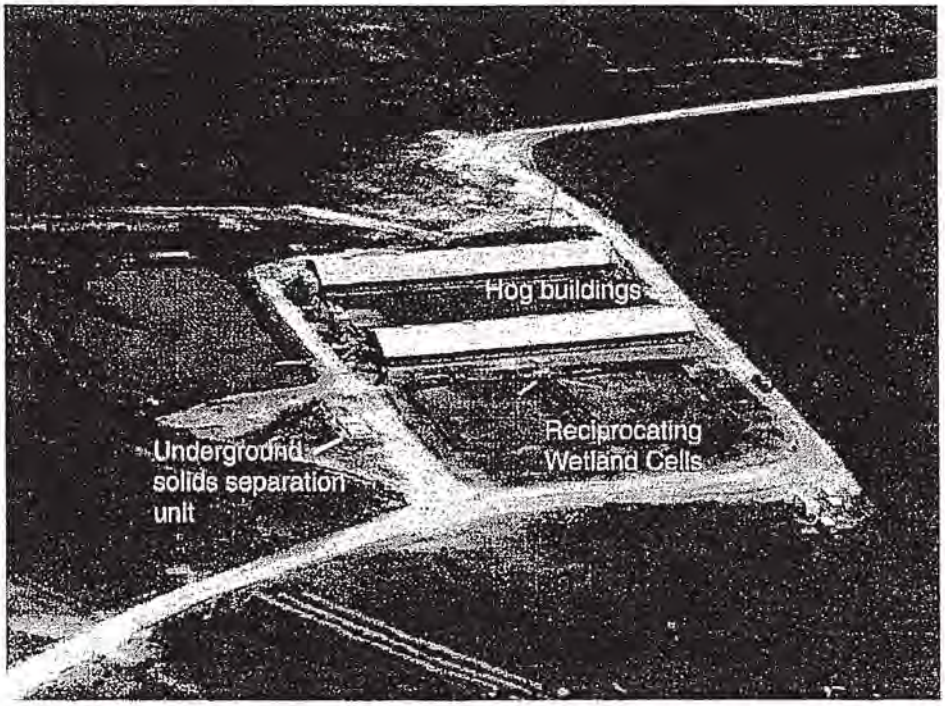


Fig. 2. Aerial view of the reciprocating wetlands system.

flow biofilters connected in series (two units, four biofilters total). Each biofilter contained plastic fixed media providing surface area for a biofilm of microorganisms. Under aerobic conditions the bacteria catabolized the organic compounds in the wastewater resulting in reduced biological oxygen demand (BOD) and odorants as well as conversion of ammonia to nitrate nitrogen (nitrification). An aerial view of the treatment system is shown in Fig. 3.

FUTURE PERSPECTIVE

Sustainable agriculture requires production and distribution systems that minimize adverse effects on health,

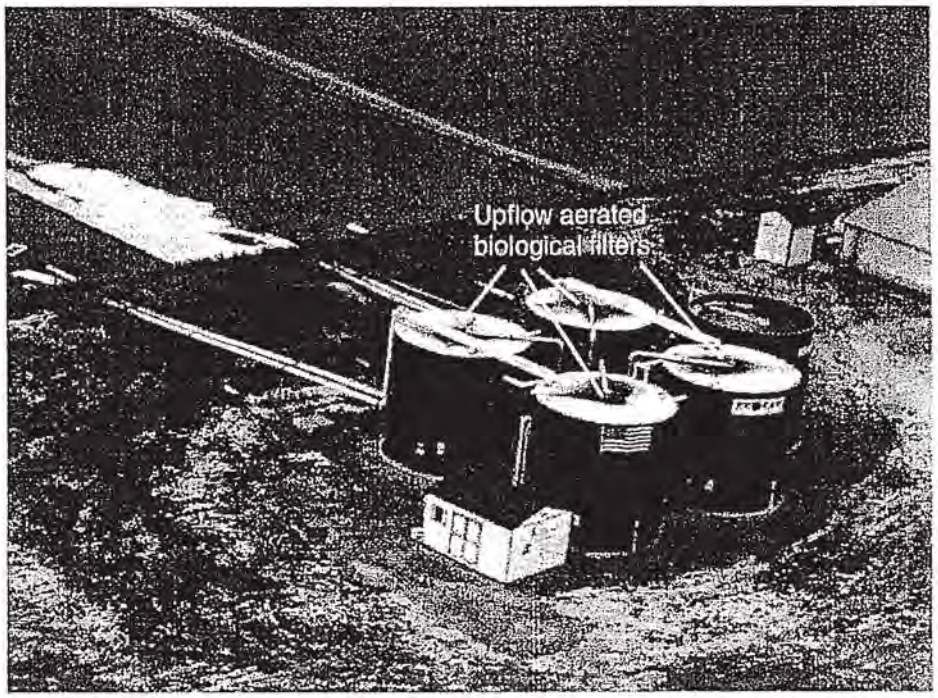


Fig. 3. Aerial view of the upflow aerated biological filter system.

safety, and the environment. Practices must be economically viable, environmentally sound, and socially responsible. This includes reduction or elimination of odorous aerial pollution that evokes health complaints and impairs quality of life in neighboring communities. Using the swine industry as a model, the continued sustainability of this industry in North Carolina represents a model of scientific, social, and political challenges regarding environmental and health effects associated with odor emissions. The technologies described in this text represent a work in progress incorporating models of coordinated research and development to address salient issues that may influence the future of animal agriculture not only in North Carolina but also in many parts of the world.

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Nova Scotia

Department of the Environment

Office of the Minister

PO Box 2107
Halifax, Nova Scotia
B3J 3B7

Our file no:

COPY

FEB 12 1991

RECEIVED
FEB 14 1991

The Honourable Thomas Siddon
Minister
Indian Affairs and Northern Development
Room #121
House of Commons
East Block
Ottawa, Ontario
K1A 0A6

Dear Mr. Siddon:

RE: PICTOU LANDING INDIAN BAND/BOAT HARBOUR

As a result of arrangements negotiated between your Department and the Nova Scotia Water Authority, a predecessor of this Department, the inlet of Boat Harbour was developed into a wastewater treatment facility for effluent from the Scott Maritimes Limited craft mill located at Abercrombie Point, Pictou County.

Three parcels of Indian Reservation Land border on Boat Harbour. With the development of the wastewater treatment facility, the waters of Boat Harbour were elevated by approximately nine feet. As such, an encroachment has occurred on the Reservation Lands.

This Department was made aware of the encroachment in September, 1990, when we were so advised by Mr. Don Goodwin of your Department and Mr. Robert Anderson of the Department of Justice, acting for your Department. Supporting documentation was forwarded to us by Mr. Anderson during September and October, 1990.

A careful review of these documents was carried out and in November, 1990, this Department made the following commitments:

(a) Subject to clause (d), the use of the waters at Boat Harbour as a wastewater treatment facility would be discontinued;

(b) The waters of Boat Harbour would be returned to their naturally tidal fluctuating regime;

(c) The then exposed shore line and alterations previously made within Boat Harbour would be returned to their original condition or as close thereto as can reasonably be made possible; and

(d) The approximate time frame in which the above noted activities are to take place is five years.

The reason for the five year time frame is to allow for the design, assessment, and construction of an alternative facility to handle the wastewater from the mill without the need for a shut down and a resultant lay-off involving as many as 2,100 persons employed and contracted by Scott Maritimes Limited.

In November, 1990, these commitments were made on behalf of the Department by Mr. Robert Porter to Mr. Robert Anderson and Mr. Tony Ross, who acts on behalf of the Pictou Landing Indian Band. Both, Mr. Anderson and Mr. Ross were pleased and satisfied with the commitments made at the time they were made.

The Department, with the co-operation of ACOA and Scott Maritimes Limited, has since in good faith begun taking steps to honour these commitments.

On January 29, 1991, Mr. Porter was advised by Mr. Goodwin during a meeting at this office that it is now the intention of your Department to proceed with further action against Nova Scotia. This presents a very serious problem in our efforts to resolve a matter which was created and approved many years ago by both orders of government.

I am writing to confirm to you that this Department fully intends to honour the above noted commitments. In return, I expect that the need perceived by your Department and by the Pictou Landing Indian Band to proceed with further action will be put to rest, thus allowing the necessary remedial measures to continue.

I look forward to your early confirmation of the forgoing.

Sincerely yours,

Original Signed by
JOHN G. LEEFE

John G. Leefe
Minister

cc: Donald Goodwin
Anthony Ross
Robert Anderson

ROSS
BARRETT &
SCOTT
BARRISTERS & SOLICITORS

2695 Dutch Village Road
Suite 602
Halifax, Nova Scotia B3L 4T9

Tel.: (902) 455-9090 • Fax: (902) 455-1993

September 27, 1995

File #0970-006

VIA FAX & MAIL (902) 424-4556

COPY

Gregory H. Evans
DEPARTMENT OF JUSTICE (NS)
P.O. Box 7
Halifax, NS
B3J 2L6

Dear Greg:

Re: Pictou Landing - Nova Scotia/Boat Harbour

The Band has been consulted and has actively participated in the negotiations with respect to continued use of Boat Harbour in its present form as part of an effluent treatment facility. It is agreed that such term not to exceed 10 years during which period, the Band will neither take legal proceedings against the operator of the facility nor will it request that Canada institute proceedings. The Band is aware that such operation will of necessity require the continued trespass to Band lands, but only to the extent that currently exists. Nova Scotia has represented to the Band that Boat Harbour will be absolutely discontinued as a treatment facility on or before December 31, 2005 and that it will remove all man-made structures and will fully rehabilitate Boat Harbour to a standard satisfactory to the Band.

The covenant of the Band not to initiate or cause legal proceedings to be initiated is conditional upon the commitment of Nova Scotia to completely remediate the

.../2

site after the noted 10 year period and the transfer of agreed upon lands to the Band, some of which lands are to be transferred to the Band immediately and the remainder to be transferred immediately after remediation has been completed.

Yours very truly,

ROSS BARRETT & SCOTT

PER:
E. ANTHONY ROSS

EAR/ceb
cc: Chief and Council

Indian Cross Point Burial Ground Research

Final Report

Prepared for:
Denis Rushton
Manager
Environmental Services
4th Floor, Purdy's Tower 2
Halifax, Nova Scotia

Prepared by:
Douglas Brown
P.O. BOX 31064
Halifax, Nova Scotia
B3K 5T9

February 16, 1998

Indian Cross Point Burial Ground Research

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February 16, 1998

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INTRODUCTION

In the Province of Nova Scotia in the year 1784, Major Paul and Sapier, two "Indian Chieftains" of the Piktuk tribe (Mi'kmaq), sold one acre of cleared land on which a Mi'kmaq burying ground was situated to James Carmichael, a local merchant. This conveyance was in the vicinity of Indian Cross Point by the East River in Pictou Landing. In the conveyance, the burying ground was reserved for the continued use of the Mi'kmaq. A 10 foot iron cross was situated in the area and later accounts describe a 12 foot wooden cross as marking the area.

The Mi'kmaq of Pictou continued to use the burying ground for burial purposes until approximately 1867. It was reported that a few years prior to this, a number of Mi'kmaqs turned out and repaired the burial site due to the effects of tidal erosion which had caused human remains to spill out onto the shore of the East River.

The cross which marked the area was subsequently lost and the exact location of the burying ground became forgotten over time and disuse. An inquiry initiated by the Province into locating the burying ground was begun in 1995 but yielded nothing. A renewed effort to locate the burying ground began in September of 1997 as a good-will effort of the Province toward the Pictou Landing Band. The author was contracted to perform the research leading to the discovery of the lost burial site. The object of the search was to locate the site in order to acquire it and ultimately transfer it back to the Pictou Landing Band.

Athough no archaeological confirmation has occurred as of yet, the location of the burying ground has been sufficiently narrowed enough to warrant such a survey on the southern coastal portion of property owned by Mr. and Mrs. William Palmer of Pictou Landing. After informing Mr. and Mrs. Palmer of the aims of this project, the Province secured permission to perform an inspection and archaeological survey of the area suspected to be the burial site in order to determine first, if the burial ground is located there, and second, the parameters of the site.

The research used to formulate this report was gathered from the following institutional sources: the Department of Natural Resources, which provided information such as maps, plans and original Crown grants; the Nova Scotia Public

Archives, from where historical references as well as maps were gathered; the Pictou County Registry of Deeds, which contained property descriptions and conveyances; the Pictou County Registry of Probate, which had references to property passed in succession; the Nova Scotia Museum of Natural History, which provided key information contained in their site record of Indian Cross Point; the Confederacy of Mainland Micmacs, which provided me with their own research file regarding the site; the Pictou Landing Band Council, which gave me access to their research file on the site, and the Mi'kmaq Historical Society which offered their expertise and continued assistance and support since they first learned of the project. Numerous individuals from the Mi'kmaq community as well as those associated with the above institutions also offered valuable advice which guided the research efforts of this project.

This report contains three main sections concerning first the history of the site, second, the chain of title, and third, the cartography of the area which is included in Appendix A. There is also an Appendix B containing land descriptions not used in the body of this report. This report details the reasons why an archeological survey should be conducted on the property identified as being the suspected burial site.

HISTORY OF THE BURYING GROUND AT INDIAN CROSS POINT

One part of researching the forgotten burial site at Indian Cross Point was to look up any materials referring to it in the annals of history. Several such references were found and compiled although the ratio of failed attempts far exceeded the successes of the search. For obvious reasons, only the successful attempts are included in this report and are listed below in the following pages.

In the Illustrated Historical Atlas of Pictou County (J.H. Meacham and Co.: 1879), the following passage appears at p. 6:

> Here stood at the arrival of the English settlers an iron cross about ten feet high, hence the place is still known as Indian Cross Point. In this place the Indians buried till a few years ago. Many of the graves can still be traced by the rows of flat stones by which they were originally covered, which have now sunk to the level of the ground, and probably were always in that position, and are partially overgrown with grass. Human bones may frequently be found on the shore, caused by water wasting away the bank.

The passage above clearly indicates that the burial site was at the bank of the shore of the East River. It also notes that the graves were marked by rows of flat stones. It is doubtful, however, that the ten foot iron cross was still in existence at the time of publication.

Another reference to the burial ground and 10 foot iron cross is found in The History of the Catholic Church in Northeastern Nova Scotia (Antigonish: St. Francis Xavier University Press, 1960-71) v. I, p. 75, where it states:

> There was an Indian village at the mouth of the East River, and a short distance to the south of this village there was an Indian cemetery which was marked by an iron cross ten feet high. The cross was still standing at the early part of the nineteenth century, and its site bears the name of Indian Cross Point to this day.

Some mention of a site that is likely the lost cemetary at Indian Cross Point was made in the publication by W. J. Wintemberg entitled Some Shell Heaps in Nova Scotia, (Bulletin No. 47, Anthropological Series No. 9, 1929), at p. 15, where it states: "...stone axes or celts, and knives were found a few hundred yards north of Indian Cross Point, a little below Ives Point." Although this reference does not venture to say whether the findings were dug up from the cemetery under search, the inference is very plausible given that W.J. Wintemberg visited the site in 1913 after reading an article published in the *Pictou Advocate,* dated September 14, 1912. Wintembergs' findings were subsequently recorded in the Nova Scotia Museum's Archaeological Site Record which characterized them as "prehistoric". The article that inspired Wintemberg's visit to the site, written by D. McLeod under the heading "Old Time Recollections" stated in part as follows:

> The Indian Cross Point, less than a mile from the old coal wharves, was for many generations the burial place for the Indian dead. It was marked by a deal cross about 12 feet high, and plainly visible from vessels passing up and down the East River channel. The cross was renewed three times within my recollection. They ceased using the ground for burial purposes some forty-five years ago.
>
> During heavy storms and high tides in autumn the bank around the Point gradually wore away, and several of the graves nearest the harbour were undermined and fell over onto the shore. As those dead had probably lain in the graves for over a century, nearly every vestige of their remains had decayed into dust, but occasionally a piece of bone, a tuft of raven hair, a decayed fragment of a coffin, some fibrous substances (probably the remains of an old blanket) or a number of rusty nails would be visible in the fallen ground.

> One day, over fifty years ago, the Indians turned out in force to repair the breach that time and tide had made on their old burial ground. Their first duty was to gather up every fragment that seemed to belong to the fallen graves. Those relics they interred in a new grave, a short distance inland from the bank. They then piled up boulders and smaller stones at the base of the bank to protect it from future storms.

Several important points are raised by the above passage. First, the location of it was on or near the bank of the shore of the East River. Second, coffins were used in at least some of the burials and the coffins had metal nails. Third, the Mi'kmaq buried their dead there until about 1867. (This is also the same year that Margaret McConnell sold the land on which it was likely situated to John Fraser, see next section). Fourth, there are newer graves a little inland from the bank where the Mi'kmaq reinterred the remains that had fallen from the erosion. Fifth, the Mi'kmaq attempted to stop the erosion by placing large and small boulders at the site of the erosion. Sixth, a twelve foot deal cross (wooden) was renewed three times within the recollection of D. McLeod who wrote the article in 1912. And finally, the burial site itself must have been up on a higher ground for the remains to have fallen to the shore and this higher ground was located "around the Point" as opposed to "at" the Point.

In George Pattersons' The History of the County of Pictou (Montreal: Dawson Brothers, 1877) at p. 187 it states:

> The only land in the county, so far as we have been able to ascertain, reserved for them in Government grants is a small lot at their burying ground, at the mouth of the East River, but this they sold to the late James Carmichael, with the exception of the burying ground itself.

This passage suggests that the burying ground area was granted to the Mi'kmaq by the Crown. I have found no evidence of such a grant. Rather, the evidence appears to be that the Crown granted land all around the area but did not grant land comprising the area at any time. The Pictou Landing Indian Reserve was not the subject of a grant until 24 August, 1863 and did not include the tract noted above.

The sale referred to by Rev. George Pattrerson above is again mentioned in John H. Sinclairs' The Life of James W. Carmichael and some Tales of the Sea (Halifax: T.C. Allen & Co., undated) at p. 13 where it states:

> James Carmichael, the grandfather of James William Carmichael was a native of Aberlour, Banfshire, Scotland. He emigrated to America in 1778. He first settled in Pictou. In 1783 he obtained a grant of land and settled on the southern side of the Harbour. He died March 16th, 1836. The quaint old record

> in the family Bible informs us that Ann, his spouse, died in 1830, aged 82 years. She was a native of Morayshire, Scotland.
>
> In those early days a town was laid off at Fisher's Grant called "Walmsley", but it was only a town on paper and even the name has been forgotten. The whole East River valley at that date was a forest, from Pictou Harbour to Sunny Brae and beyond. The Indians claimed certain rights to the land. The white settlers were anxious to conciliate them. Mr. Carmichael recognized the Indian's title and submitted to the formality of securing a transfer of a small lot claimed by them, forming part of his homestead. One of the relics of those early days still in the possession of the family is an old deed which reads as follows: . . . [see Appendix B, Book 2, Page 137 for the contents of the deed]

Although Mr. Carmichael recognized the Indians title and secured a transfer, the transfer itself was likely not performed according to the procedure laid out in the Royal Proclamation of 1763 which essentially proclaimed that Indian lands could only be surrendered or sold directly to the Crown by the Indians. Indian land could not be alienated directly from the Indians to a settler.

The paper town named "Walmesley" where the deed to James Carmichael was executed is mentioned in Joan Dawson's The Mapmakers Eye (Halifax: Nimbus Publishing and the Nova Scotia Museum, 1988) at pp. 124 where it states:

> In the expectation of a considerable influx of settlers, a town was surveyed and laid out on the east side of Pictou Harbour, at what is now Pictou Landing. It was to be known as Walmesley, and like other "instant" towns of the period, was to consist of a rectangular townsite with a common close at hand. Unlike most of Morris' projected towns, this one came to nothing, and it was at a site on the opposite side of the harbour that the town of Pictou was established by John Patterson in 1787.

At p. 125, Dawson includes a map dated 1785 by Charles Morris who was commissioned by the Crown. This map also shows the area around Indian Cross Point and includes a triangular lot labelled "Indian Burying Ground" adjacent to the lands granted to Walter Murray. Concerning the burying ground lot, Dawson remarks at p. 124:

> A final point of interest, which predates all the other dispositions of land recorded here, is the "Indian Burying Ground" at the mouth of the East River. Although the story goes that the local natives dispersed in haste on the arrival of the *Hector* and its passengers with their piper, the existence here of their burial ground attests to their presence in the region long before the coming of the white man. It is interesting to note that the site was preserved when the surrounding area was being divided up among the settlers. Whether this gesture was made out of fear or out of respect, it allowed a token of the earlier history of the area to remain alongside the new settlement.

The historical record offers two major consistencies that may be interpreted as reliable clues for the purpose of determining the whereabouts of the lost burying ground at Indian Cross Point. The first consistency is that the burying ground is located on the bank of the East River on a part that was subject to the effects of tidal erosion. The second major consistency is that the Indians sold the tract of land containing the burying ground to James Carmichael in 1784. This fact proved extremely important as it was used to break through the impasse encountered during the earlier stages of research at the Pictou Registry of Deeds. Other consistencies, such as the fact that a ten foot iron cross once marked the area, (and then a twelve foot deal cross) do not hold as much significance due to the fact that they are no longer present at the site, or at least were not detected by visual inspection of the area.

REGISTRY OF DEEDS

Collecting data concerning original Crown grants as well as subsequent conveyances was a task that, although arduous, was significant to the determination of the approximate area where the burial site is most likely situated. Generally, there was a Crown grant of the land adjacent to the south of the area of Indian Cross Point and there was another Crown grant of land to the adjacent north of Indian Cross Point. There was no Crown grant of the land between these two grants which, when shown on maps, is a triangular parcel approximately 50-60 acres in size. The following data traces the original Crown grants in the area in question (Indian Cross Point), and the subsequent disposition of the land contained in the grants. It also traces the disposition of the land that was ungranted on which the burial site was located, which was sold to James Carmichael directly by two "Indian Chieftains". This section will likely remain fairlyobscure to the reader without the aid of maps. Helpful maps are contained in Appendix A of this report with some explanation attached.

In 1783, the Crown granted a tract of land (either 280 acres or 350 acres) to Walter Murray on the eastern shore of the East River "near the Indian burying ground" (Department of Natural Resources: Old Grant Book 13, Page 12). Two years later, Walter Murray sold 200 acres of his tract to James Carmichael (Pictou Registry of Deeds: Book 2, Page 155).

Around the same period of time, the Crown granted 100 acres of land to James McPherson, also on the east side of the East River to the north east of the grant to Walter Murray (Department of Natural Resources: Old Grant Book 20, Page 102). In 1784, James McPherson sold the entire tract to Donald Campbell (Pictou Registry of Deeds: Book 2, Page 365).

The shape of these two grants had in effect roughly formed a triangular lot on the eastern shore of the East River which remained ungranted land. This ungranted area is estimated to be between 40-60 acres in size and was seemingly never the subject of a Crown grant. It was somewhere in this triangular shaped lot near the shore of the East River that the Indian burying ground was located. This is also the likely reason that the land was never the subject of a Crown grant.

In 1784, a questionable conveyance of property occurred between two Mi'kmaqs and a local settler from Scotland named James Carmichael. It was worded as follows:

> We Major Paul and Sapier the two Indian Chieftains of the Pictou Tribe for ourselves and in name of the other Pictou Indians for a certain sum of money now paid to us by Mr. James Carmichael, make over to him and his heirs one acre of cleared lands less or more joining Indian Cross reserving the Burying Ground to ourselves given under our hand at Walmsley the Twenty Sixth day of August, 1784. (Pictou Registry of Deeds: Book 2, Page 137)

It is presumed that the one acre of cleared lands, as well as the burying ground, was located within the triangular shaped ungranted land between the James McPherson grant to the north, conveyed to Donald Campbell and the Walter Murray grant to the south, conveyed to the same James Carmichael. James Carmichael then owned 200 acres of land to the south of the triangular ungranted lot as well as one acre from within the triangular lot. Donald Campbell owned 100 acres to the northeast adjacent to the triangular lot.

Donald Campbell sold 50 acres of his 100 acres to Dugald McIntyre in 1805 (Pictou Registry of Deeds: Book 2, Page 378). This 50 acres was located closest to the northeastern line of the triangular lot and began "...at James Carmichaels north line on the bank of the shore and running the several courses of the shore...". This description is important because it describes the beginning point as being at James Carmichaels north line. James Carmichael only owned two pieces of property in the area, one of them being where the burying ground was located and the other being

further south which was once part of the Walter Murray grant. The description of the 50 acres is a key indicator that the burying ground is located at the northern-most area of the triangular lot located between the Walter Murray Grant and the James McPherson grant at the bank of the shore. (see figure 4a Appendix A). This point on the shore of the East River is approximately a few hundred yards north of Indian Cross Point.

In 1810, presumably after the death of Dugald McIntyre, Angus McIntyre conveyed the same 50 acres to Richard Peacock (Pictou Registry of Deeds: Book 4, Page 75). Richard Peacock then conveyed it to Donald McGregar in 1810 (Pictou Registry of Deeds: Book 4, Page 76). After the death of Donald McGregar, Malcolm McGregar sold all but three acres of the same lot to Donald McDonald in 1820 (Pictou Registry of Deeds: Book 12, Page 74). Donald McDonald already owned other land in the vicinity and when he died in 1860, he left 110 acres to his son Daniel McDonald which included the same 50 acre lot. (Pictou Registry of Probate: 4 P.O. - 159 -1860).

In 1834, James Carmichael conveyed a 34 acre parcel of land to Margaret McConnell described as:

> ...being at Indian Cross so called butted and bounded as follows beginning on the eastern shore of Pictou harbour at the southern boundary of lands owned by Donald McDonald and from thence southerly the various courses of the harbour until it meets the original boundary of the east river lots at a cold well on the edge of the marsh thence to run east until it meets the southern boundary of lands owned by Donald McDonald aforesaid thence to run north 5 degrees west along the said Donald McDonalds southern line until it meets the harbour at the place of beginning containing by estimation 34 acres... (Pictou Registry of Deeds: Book 21, Page 72).

This description is significant in that it implicitly concedes that the parcel is situated on land that was never granted. It does this when it says "until it meets the original boundary of the east river lots". Thus, the place of beginning, that is, at the southern boundary of lands owned by Donald McDonald, is likely the area that Carmichael purchased from the Indian Chieftains. It appears from this conveyance that James Carmichael bought one acre of cleared land but sold it to Margaret McConnell as 34 acres. McConnell held on to this property until 1867 at which time she conveyed it to a John Fraser (Pictou Registry of Deeds: Book 54, Page 661).

In this conveyance, the 34 acres is described as "being in Fishers Grant" while in the previous conveyance of the same lot, that is, from Carmichael to McConnell, it is described as "being at Indian Cross". I cannot explain why this difference in the description of the same parcel exists although I can speculate. According to an article in the Pictou Advocate, the Mi'kmaq stopped burying their dead at the burying grounds at around the same time that John Fraser acquired the lot from Margaret McConnell, that is, in 1867. It is possible that John Fraser did not want the Mi'kmaq to bury their dead on his newly acquired lot and substituted the reference to "Indian Cross" with a reference instead to "Fishers Grant".

In 1904, Daniel McDonald conveyed a 150 acre lot to Elwood McDonald (Pictou Registry of Deeds: Book 162, Page 306). This 150 acres included the 34 acre lot that was conveyed to John Fraser from Margaret McConnell in 1867. This means that between 1867-1904, Daniel McDonald acquired John Frasers lot. The year and how this came about remains a question as there was nothing at the Registry of Deeds in Pictou documenting such a transfer. It was likely not registered. Nevertheless, the description of the 150 acres clearly demonstrates that the 34 acres on which the burying ground is probably located became part of Elwood McDonalds' property. The description is as follows:

> ...beginning at a point on the shore of the waters of Pictou harbour at the southwest corner of land belonging to the heirs of the late Catherine McDonald of South Pictou and running in a south easterly direction along said Catherine McDonalds lands and the line of lands of the heirs of the late William McKenzie until it comes to the line of lands of one James Ross thence in a south westerly direction until it comes to the Fishers Grant line thence along said Fishers Grant line until it comes to the north line of lands of John Vaux thence along the line of John Vaux's land to the waters of Pictou Harbour thence along the various courses of the shore to the place of beginning containing 150 acres...

This 150 acre lot, excepting the small lot containing the Greenwood Cemetery, was then conveyed by Sherriffs Deed to James R. Porter in 1929 after the death of Elwood McDonald (Pictou Registry of Deeds: Book 233, Page 131). James Porter then conveyed the lot to John Baker in 1931 (Pictou Registry of Deeds: Book 244, Page 171).

John Baker then conveyed 80 acres of the 150 acre lot to the Nova Scotia Land Settlement Board in 1933 (Pictou Registry of Deeds: Book 249, Page 104). This 80 acre parcel contained at its southern most shoreline the northern piece of the original 34 acre lot containing the burying ground that was conveyed from James Camichael to

Margaret McConnell to John Fraser to Daniel McDonald to Elwood McDonald to James Porter to John Baker. The Nova Scotia Land Settlement Board then conveyed this 80 acre parcel to Silas Grattos in 1951 (Pictou Registry of Deeds: Book 350, Page 162). This parcel then became subject to an easement to Her Majesty the Queen in 1966 (Pictou Registry of Deeds: Book 511, Page 67). (The easement refers to the pipeline that was constructed for effluent transport and is very close to the south of the area likely to be the burying ground.)

Silas Grattos then conveyed the parcel to Margaret Paton in 1981 (Pictou Registry of Deeds: Book 767, Page 469), who in the same year conveyed it to Richard Bedard (Pictou Registry of Deeds: Book 796, Page 1). Richard Bedard conveyed the lot to William Palmer in 1985 (Pictou Registry of Deeds: Book 885, Page 527), who is the current owner of the property on which the burying ground is likely located. (There were other smaller lots conveyed out of the 80 acre lot, but these lots were in the northern part of the parcel and are not located in the area of the suspected burial ground.)

CONCLUSION

The most important points regarding the determination of the location of the burial site is that firstly, the land on which the site was located was never the subject of an original Crown grant. Instead, it was on land that was sold directly from the Mi'kmaq chiefs to James Carmichael and was only one acre in size. Secondly, James Carmichael sold the tract containing the one acre to Margaret McConnell as 34 acres (thereby violating the *nemo dat* principle which essentially means that one cannot give what one does not possess). Thirdly, the point on the shore of the East River noted in Book 2, Page 378 is described as being "... at James Carmichaels north line...". The significance of this description is that it could only be referring to the north line of the land which Carmichael bought from the Mi'kmaq chieftains since Carmichaels other land in the area was relatively much farther south. This point on the shore of the East River is approximately a few hundred yards north of Indian Cross point. This point is consistent with the location of Wintembergs findings in 1929, and also consistent with a location where it is obvious by visual inspection that tidal erosion had occurred with some frequency above and beyond other areas on the same shoreline. The last important point is that the area in question is located on

land belonging presently to Mr. and Mrs. William Palmer. As mentioned earlier, the Palmers are aware of this project and have given their permission to inspect the area and perform an archeological survey. The maps contained in Appendix A show much more clearly what the words above attempt to explain.

RECCOMMENDATIONS

1. Have an archaeologist, possibly David Christiansen of the Nova Scotia Museum or Bruce Stewart of Dillon Consulting, conduct a visual inspection of the identified area with the aid of a medium quality compass or metal detector. Look for signs of remains along the eroded embankment of the East River a few hundred yards north of Indian Cross Point and use the metal detector or compass to detect for any metallic objects which may possibly be nails used in coffins or some other metallic object that may have been buried with remains. Look for signs of rows of flat stones just above the eroded embankment. Make use of a steel rod to prod into the soil to detect stones or variations in soil density. (Weather permitting)

2. Such an inspection should also have present in addition to the selected archaeologist, Joel Denny and Donna Morris of the Mi'kmaq Historical Society, Dan MacDonald of the Pictou Landing Band Council, and Douglas Brown, the author of this report.

3. A copy of this report as well as any subsequent findings made from the above reccommended inspection should be forwarded to Duncan McNeil, a semi-retired geophysicist interested in possibly performing a geophysical inspection using the method of conductivity and/or magnetronic readings.

4. Perform an archaeological survey on the identified site area in the company of those listed in reccommendation 2 above. Check with David Christiansen to see whether a heritage research permit is needed in addition to the Palmers' permission. (Weather permitting, Spring).

5. Keep in contact with Mr. and Mrs. William Palmer concerning this investigation and also come to an agreement with the Palmers pertaining to the most appropriate form of compensation if site is confirmed.

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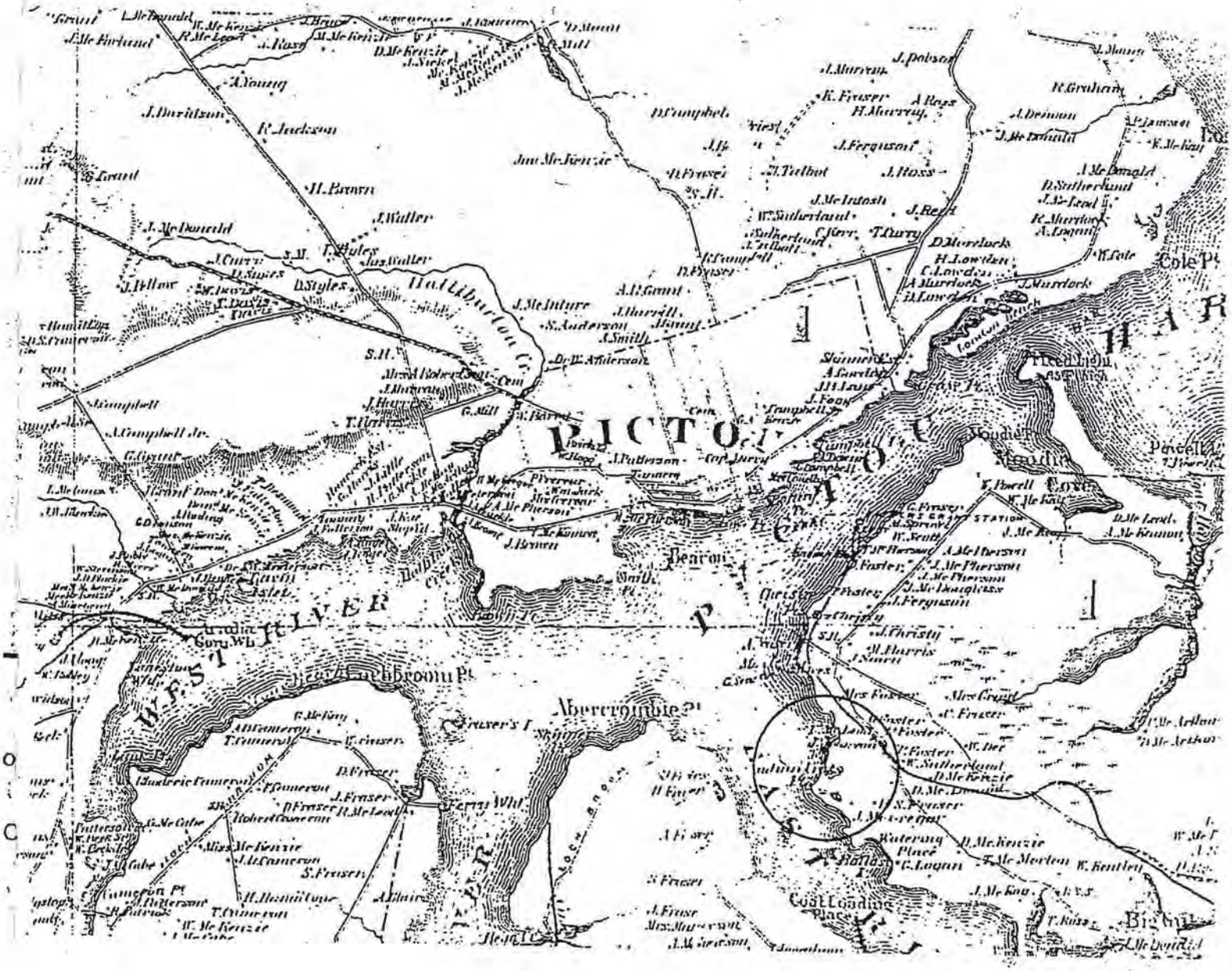
APPENDIX A

MAPS AND PLANS

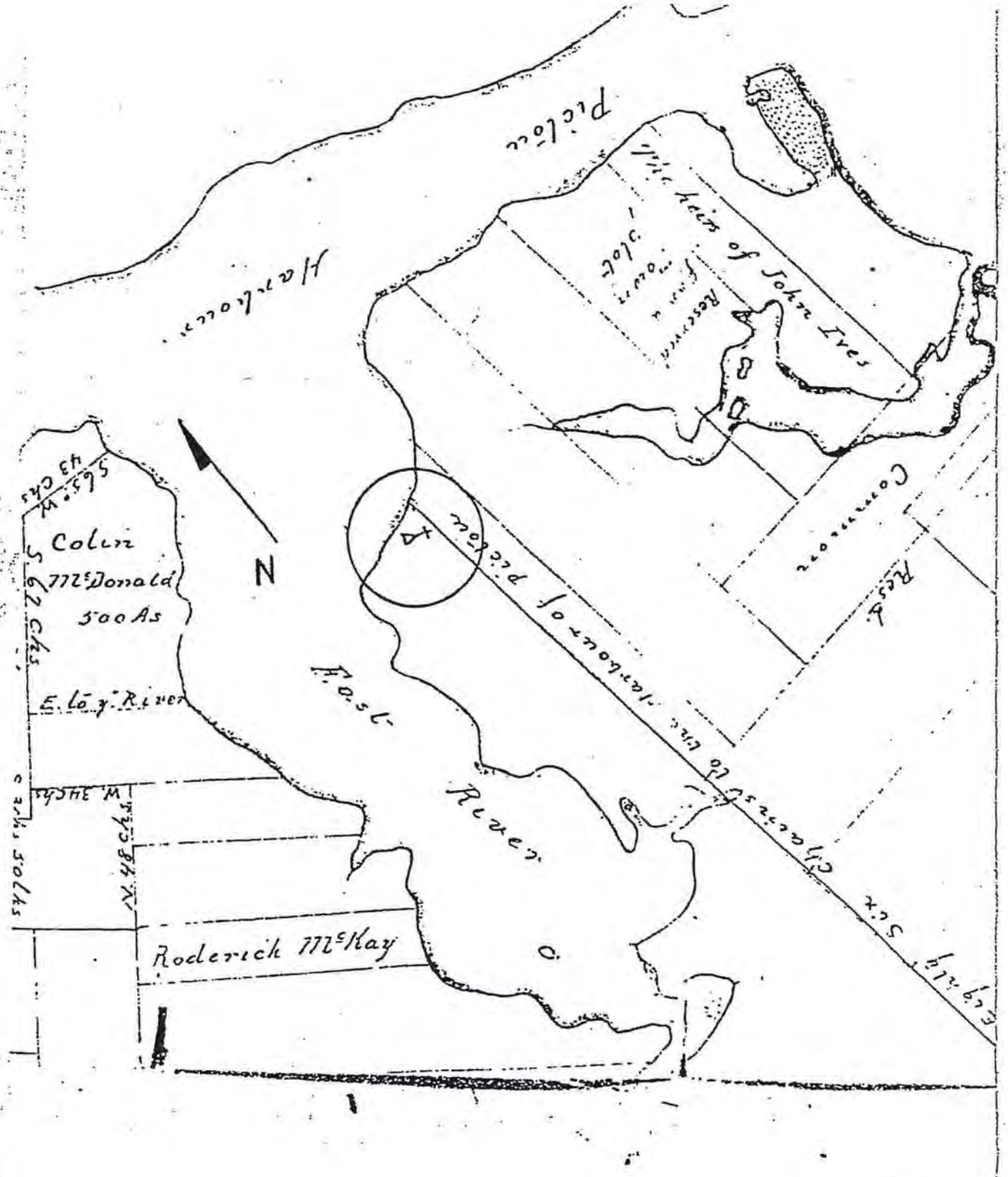
This section of the report contains some significant maps that were helpful in this project. To avoid being redundant, not all of the maps and plans I have come across are included in this section. For the most part, I will let the maps and plans speak for themselves although I have short explanations before each and have altered the maps somewhat for the sake of clarity by such methods as placing arrows or circles and showing approximate magnetic north. The only peculiar point I would raise is that of all the maps and plans I have found, none of them show the Walter Murray grant in relation to the James McPherson grant. The James MacPherson grant is laid out only once on Old Plan 199 (Fig. 5) but not in relation to the Walter Murray grant. The only consolation to this is that Old Plan 199 (Fig. 5) contains the dimensions of the grant. However, on Figure 4a, I have plotted the McPherson Grant so that the proximate relation between the two original Crown grants could be seen clearly. This relationship is also shown in Figure 7.

FIGURE 1: A.F. CHURCHES MAP, 1867

Figure 1 shows circled "Indian Cross Point" on the shore of the East River. This map is used as a mere general indication of the area in which the investigation is focussed.



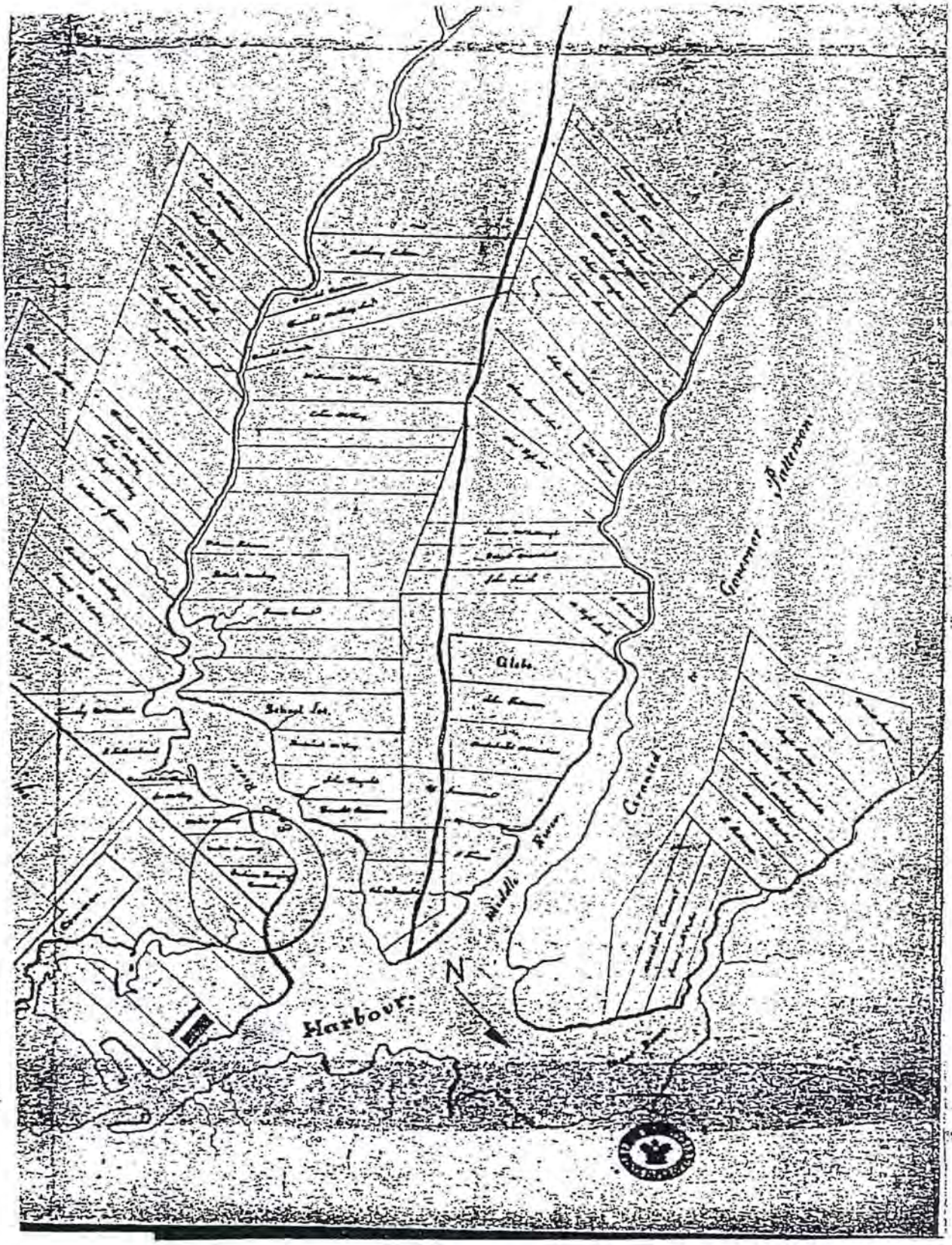
A.F. CHURCHS' MAP, 1867



OLD PLAN 195, 1784

FIGURE 3: CHARLES MORRIS MAP, 1785

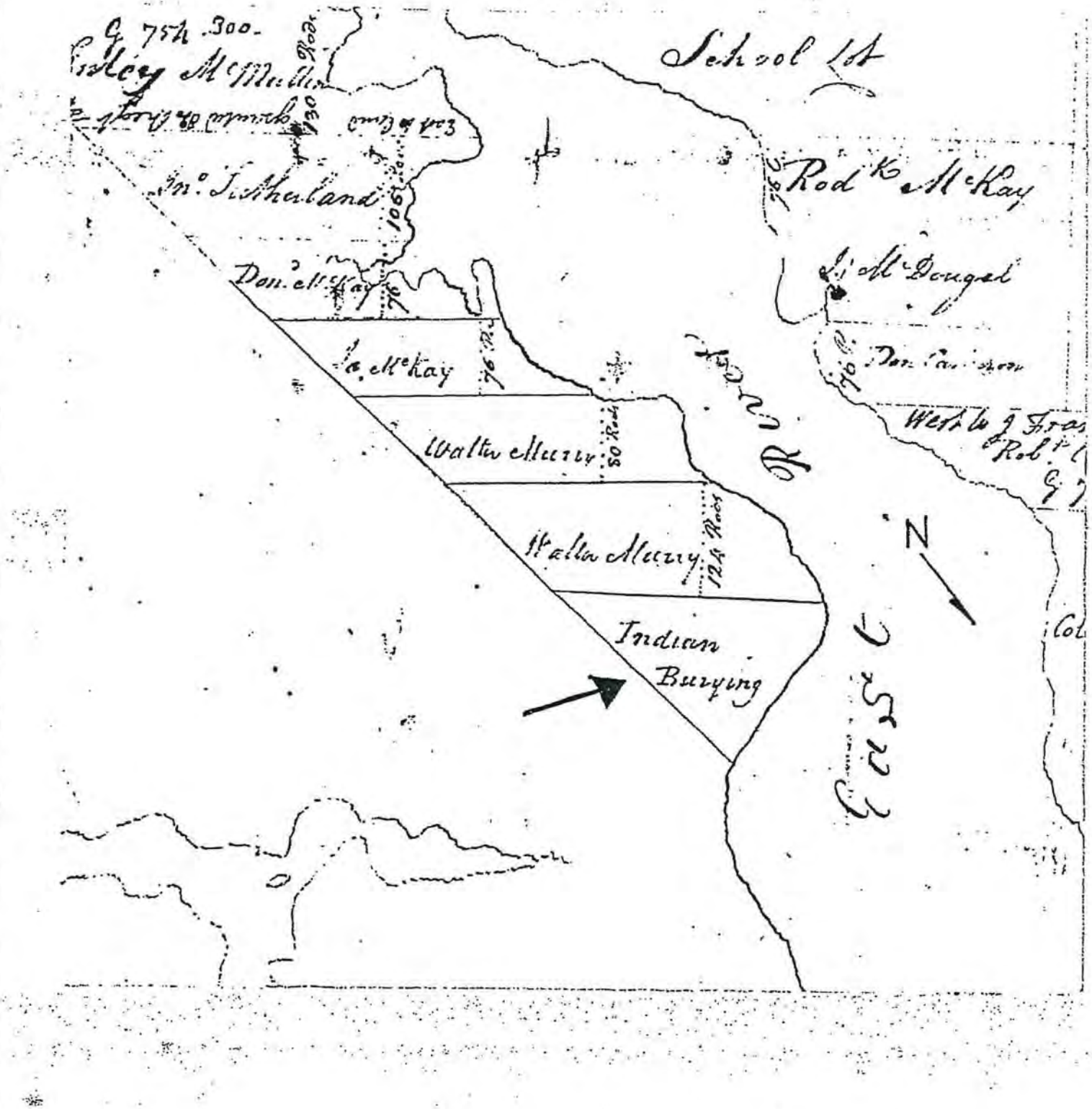
Figure 3 shows the Walter Murray grant as being adjacent to the lot labelled "Indian Burying Ground". The James McPherson grant is not shown on this map although it ends up being within the lot labelled "Indian Burying Ground". The burying ground lot is circled and is by estimation about 150-160 acres.



CHARLES MORRIS MAP, 1785

FIGURE 4: OLD PLAN 14, (Undated)

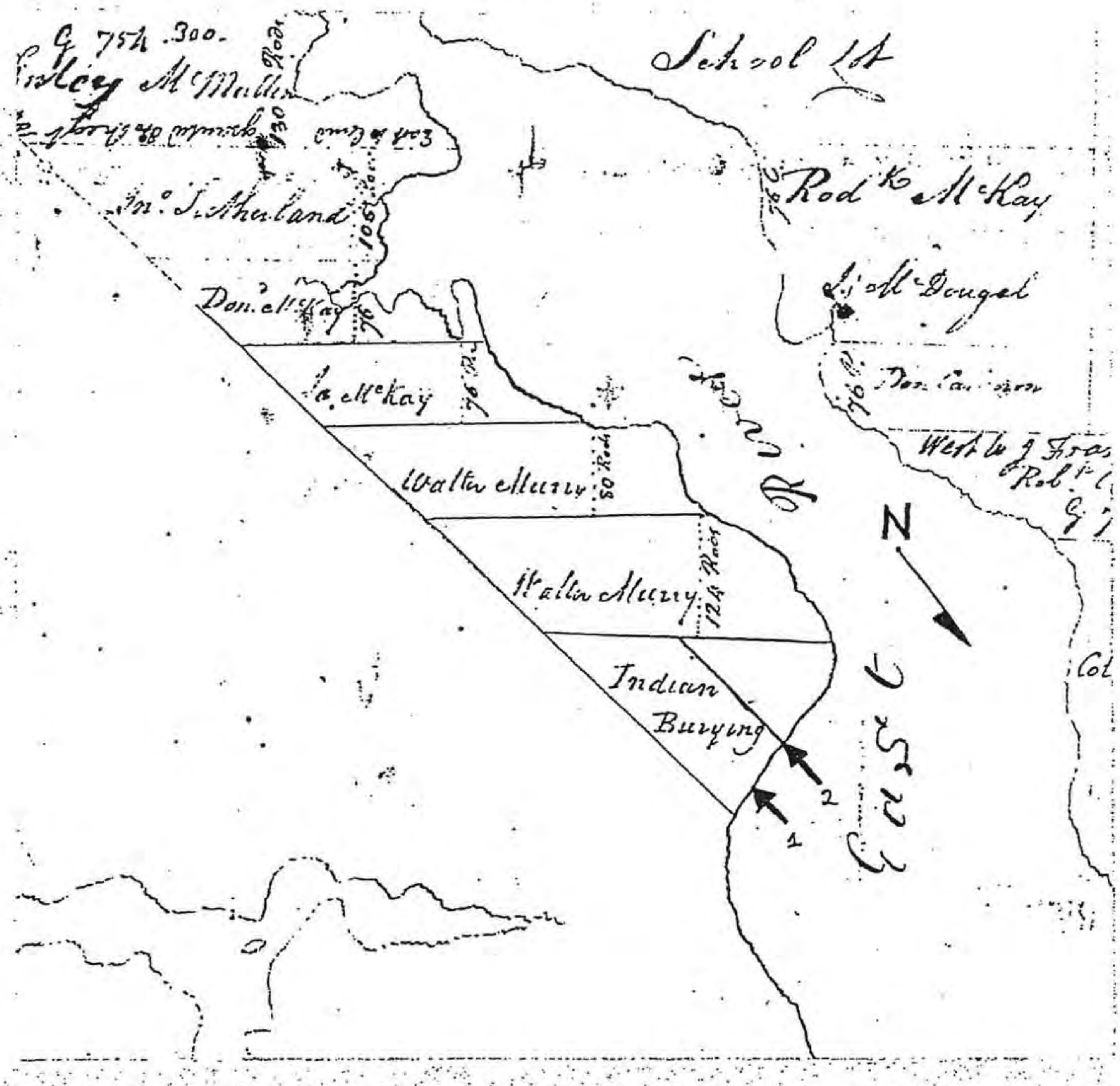
Figure 4 shows the Walter Murray grant as adjacent to the south of the lot labelled "Indian Burying" which has the arrow pointing to it. Again, the James McPherson grant is not acknowledged. This plan contains partial dimensions of the Walter Murray lots, of which there are two.



PICTOU COUNTY PORTFOLIO, OLD PLAN 14 (undated)

FIGURE 4a: OLD PLAN 14, (Undated)

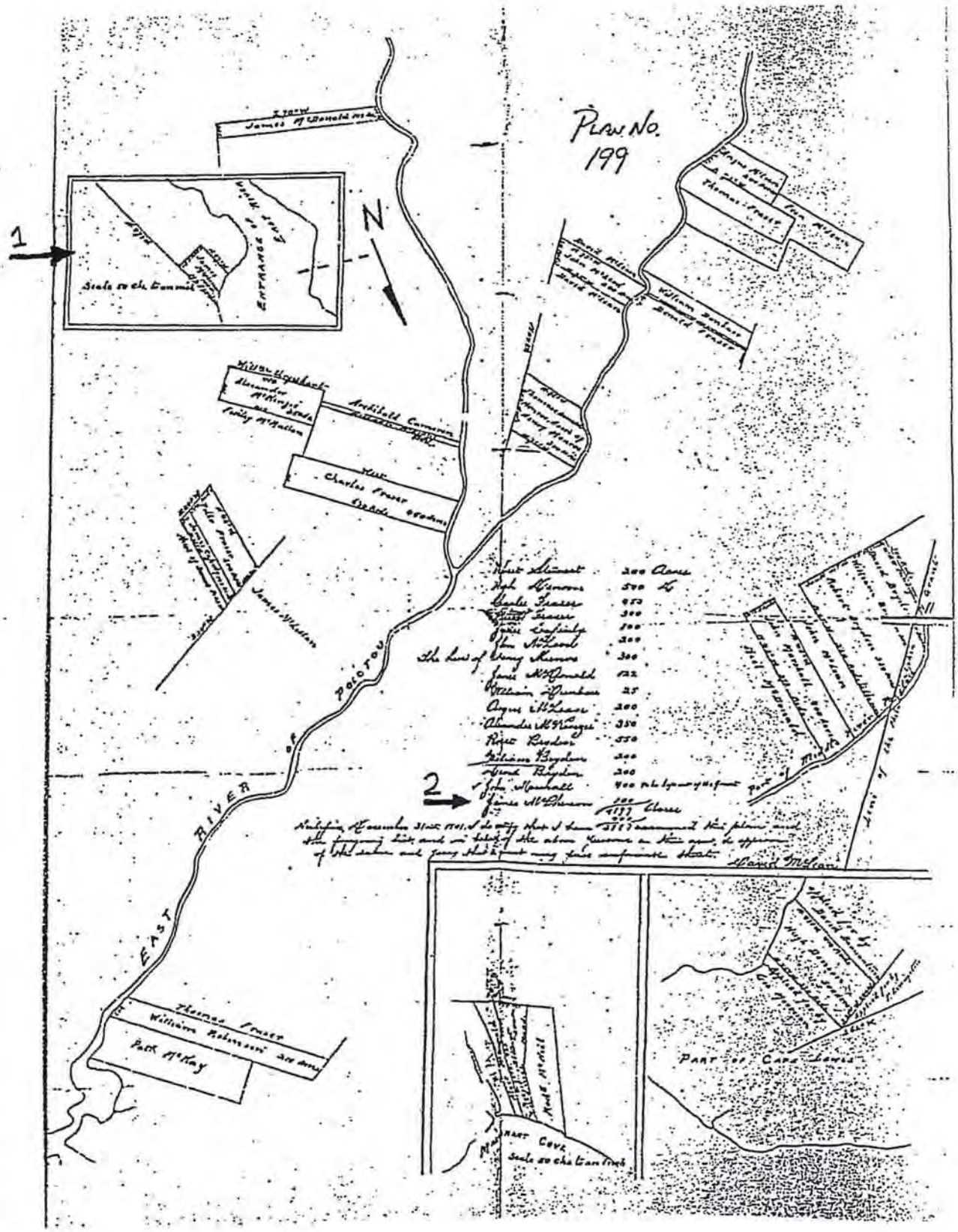
Figure 4a shows arrow #1 pointing to the area which approximates the dimesions of the James McPherson Grant of 100 acres. As one can see, the McPherson grant has the effect of reducing the triangular lot labelled "Indian Burying" by 100 acres and forming a smaller triangular shaped lot between the Walter Murray grant and the James McPherson grant. Arrow # 2 is a significant marking of a point described in a coveyance of 50 acres from Donald Campbell to Dugald McIntyre (Book 2, Page 378) which described this point as "...at James Carmichaels north line on the bank of the shore...". The significance of this point was explained in the previous section of this report at page 8, paragraph 2.



G 754 .300.
School Lot
Rod K McKay
Jn.o S. Sutherland
Don. McKay
Ja. McKay
Walter Murry
Walter Murry
Indian Burying
River
N
East C
2
1
105
76
50 Rods
124 Rods
130

FIGURE 5: OLD PLAN 199, 1801

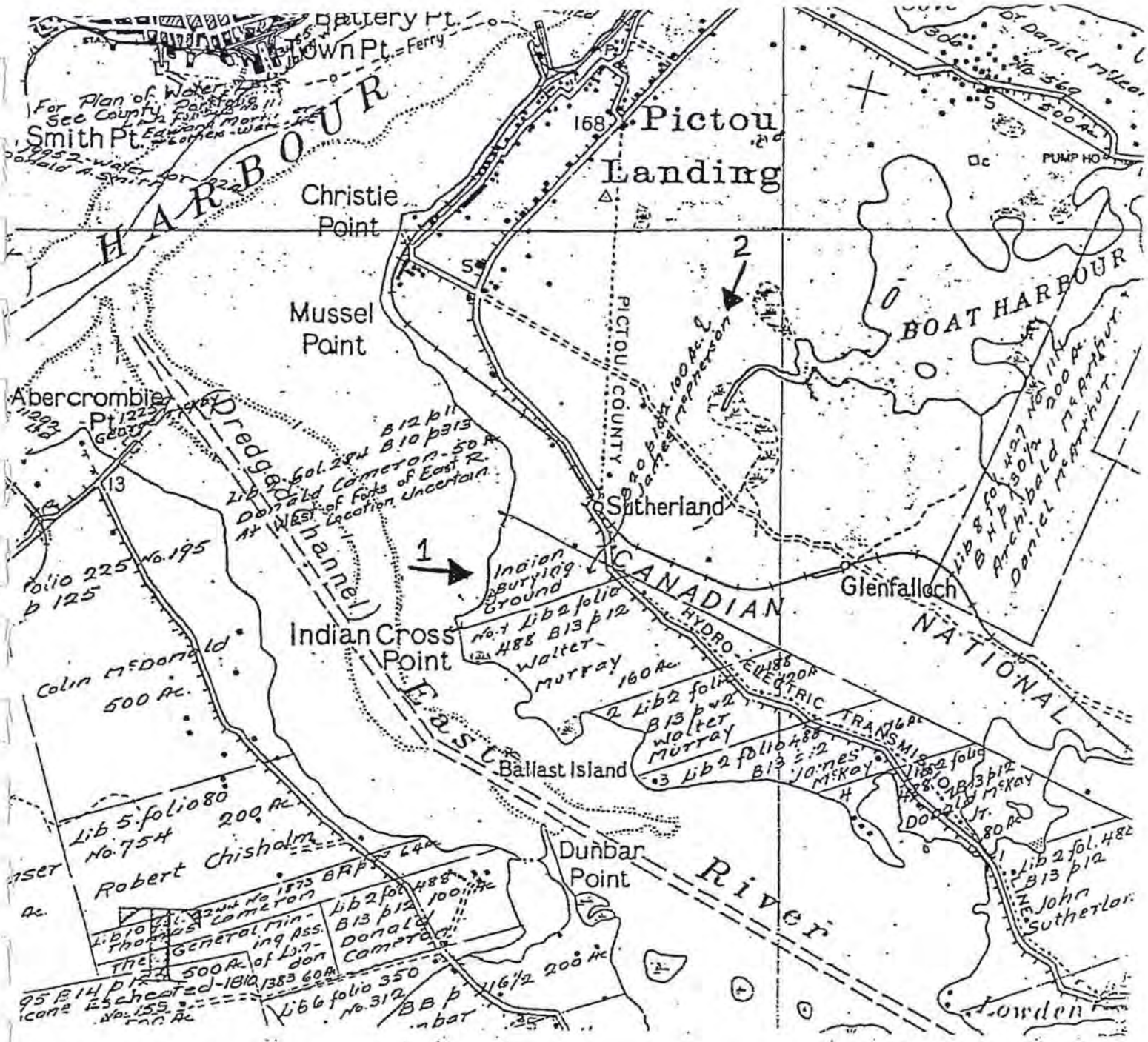
Figure 5 shows the Original Crown grant to James McPherson of 100 acres. Again, the grant is not shown in relation to the original Crown grant to Walter Murray. Arrow #1 points to the section of the Old Plan showing the dimensions of the McPherson grant which are as follows: Beginning on the bank of the shore of the East River and running along the Fishers Grant line 198 perches, thence 100 rods toward a point just south of the place named Indian Cross Point (no degrees cited), thence North 47 degrees West to the bank of the shore of the East River, approximately 140 rods. It is presumed that the line running 100 rods to a point just south of Indian Cross Point runs 100 rods along the north line of the Walter Murray grant but not all the way to the shore.



OLD PLAN 199, 1801

FIGURE 6: JACKSON SHEET 11 E-10

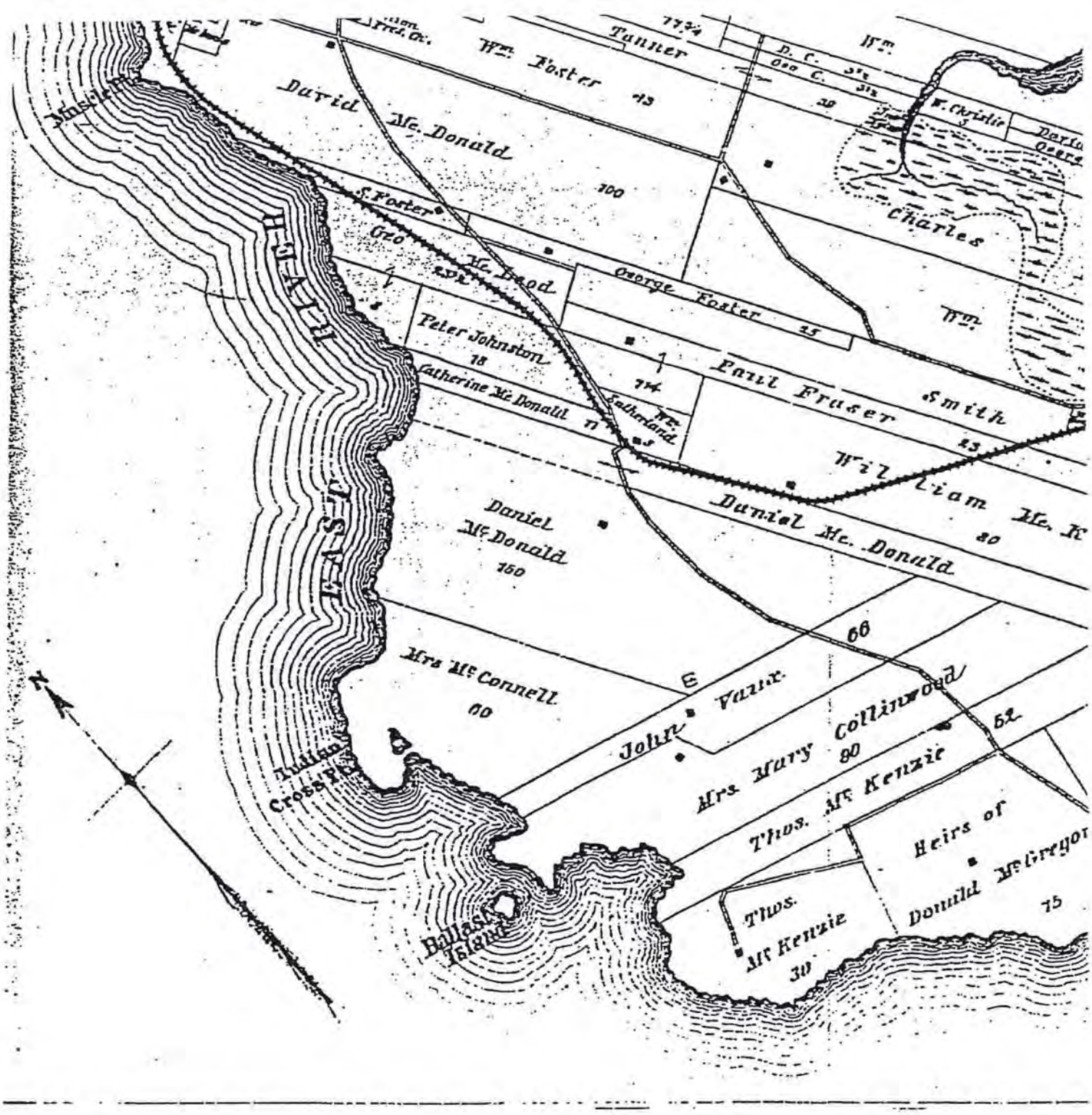
Figure 6 shows the original Crown grants in the area around Indian Cross Point. Arrow #1 points to the area labelled "Indian Burying Ground". Arrow #2 points to the citation of the original Crown grant to James McPherson. This citation itself shows an arrow pointing into the Indian Burying Ground lot but does not show the shape of the grant within this triangular lot.



JACKSON SHEET 11 E-10

FIGURE 7: PICTOU COUNTY ATLAS, SECTION 1, 1879

Figure 7 shows a property map made in 1879 which shows that the James McPherson grant became Daniel McDonalds' lot. It also shows that the northern line of the Walter Murray grant became the northern line of John Vaux. The triangular lot labelled Mrs. McConnell was not the subject of an original Crown grant at any time. Mrs. McConnell bought this property from James Carmichael who had bought only one acre and mischieviously sold it as 54 acres. (Both the shape and the amount of land described in the Deed from James Carmichael to Margaret McConnell, (Book 21, Page 72) do not match what this map portrays of the McConnell lot.)



PICTOU COUNTY ATLAS, SECTION 1, 1879

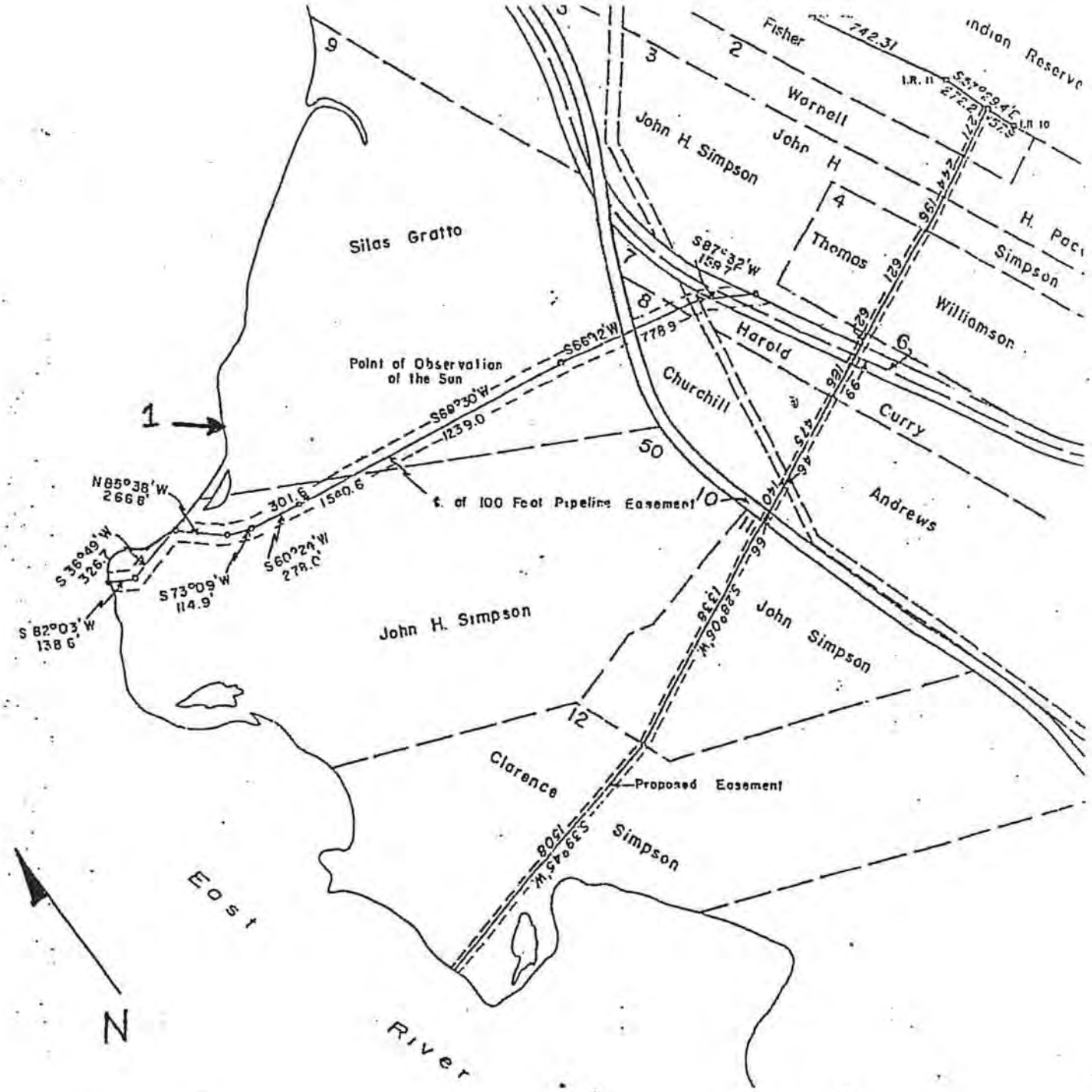
FIGURE 8: AERIAL PHOTOGRAPH, 1945

Figure 8 shows an enlargement of an aerial photograph of Indian Cross Point taken in 1945. When the photograph was originally obtained, it was in the hopes that it would show a 10 foot iron cross. Unfortunately the cross could not be detected. The value of the photograph, however, is that the rate of erosion that has taken place since 1945 could be estimated when compared to the topography map based on 1996 aerial photographs of the same area. It does not appear that much erosion has taken place when compared to figure 10.

AERIAL PHOTOGRAPH, 1945

FIGURE 9: CROWN LAND RECORDS PLAN NO. E-9-31, 1965

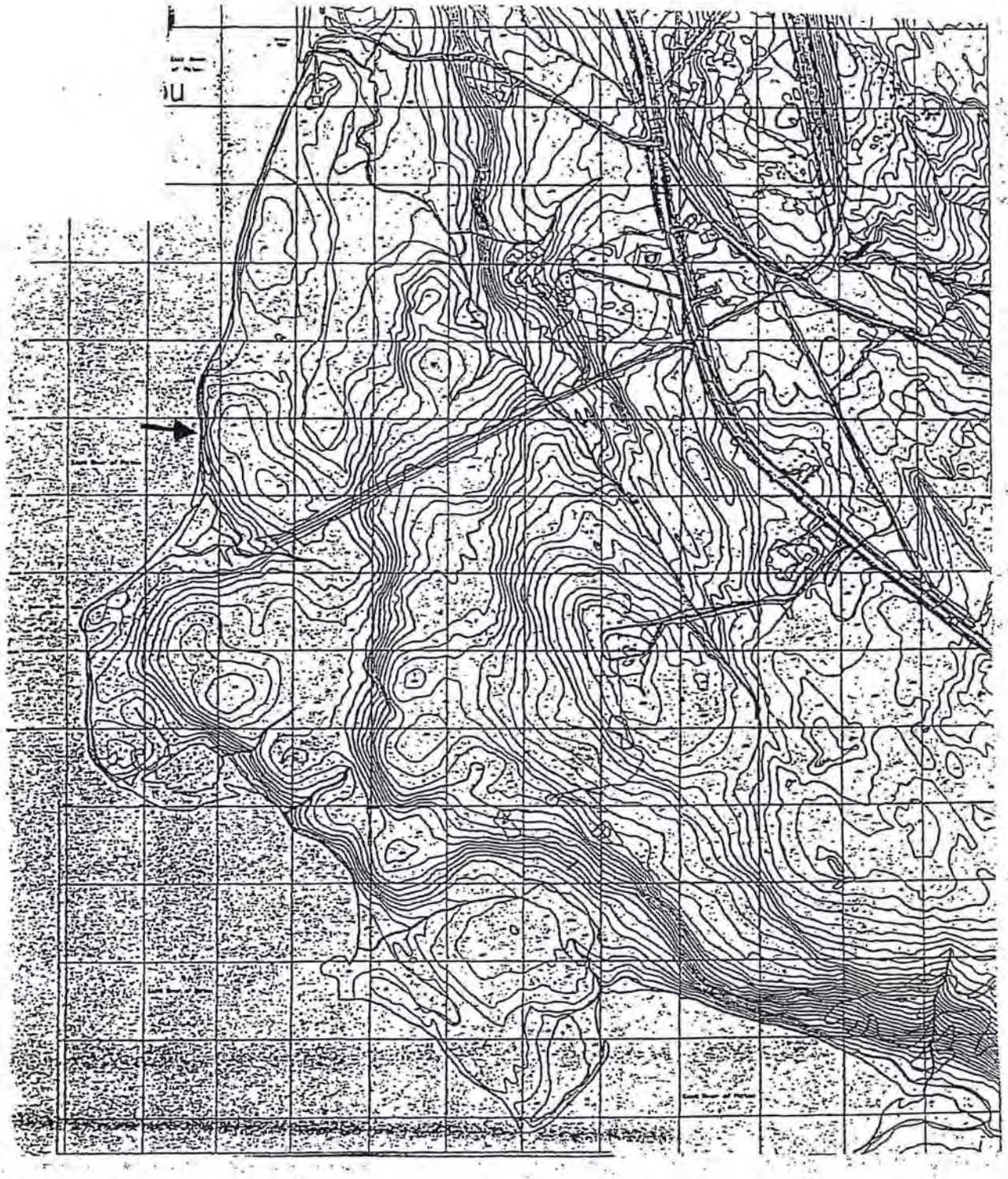
Figure 9 shows that the suspected burial site (arrow #1) is located on the land of Silas Gratto. Figure 9 also shows the location of the effluent pipeline just south of the suspected site that was constructed the following year, 1966.



CROWN LAND RECORDS PLAN NO. E-9-31, 1965

FIGURE 10: TOPOGRAPHY MAP, 1996

Figure 10 shows the topography of the area around Indian Cross Point. The arrow is pointing to the area suspected to be the burial site. This map shows that this area is on a slight hill and that the portion nearest the shore is the most eroded in the area. This eroded area was visually inspected on Feb 7, 1998.



TOPOGRAPHY MAP (Based on 1996 aerial photographs)

FIGURE 11: PICTOU COUNTY PROPERTY MAP, 1997

Figure 11 is a map supplied by the Land Registry Information Service and shows the current property lines in the area. The arrow is pointing to the suspected burial site on the land numbered 801282.

FIGURE 12: N.S.P.R.D MAP, 1998

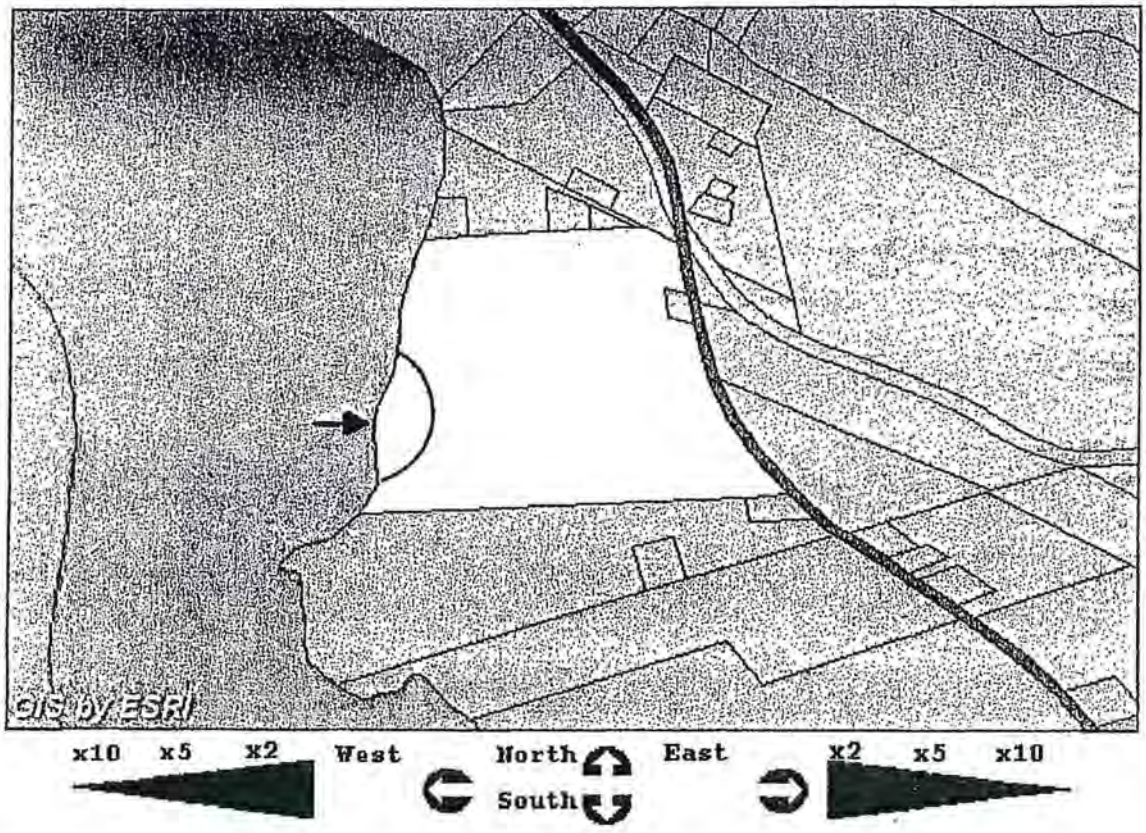
Figure 12 shows that the suspected burial site is on the lands owned by Mr. and Mrs. William James Palmer. The arrow is pointing to the area in the semi-circle which is the suspected site. Mr and Mrs. Palmer have been notified of this investigation and have given their permission to enter onto their property for this purpose.

PICTOU COUNTY PROPERTY MAP, 1997

NOVA SCOTIA Property Records Database (NSPRD)

Home Map

Housing and Municipal Affairs



x10 x5 x2 West North East x2 x5 x10

South

Selected Prope

PID	00801282
AAN	03687619
Value	$93700 (1998)
Address	Pictou Landing Rd
Owners	Palmer William Jar Palmer Susan Mary

Property Details

Center Property

Show Monument

APPENDIX B

PROPERTY DESCRIPTIONS

The following property descriptions do not include all of the conveyances up until the present. The reason for this is that the later descriptions, that is, those of the 20th century, are quite clear and legible. Thus, there is no real need to include them in this appendix. The year located in parenthesis is the year the document was executed; the other year next to "R:" is when the document was registered.

Crown Grant to Walter Murray (1783) R: 1783 Old Grant Book 13/12

...Unto the said Walter Murray alias marraw Lot number 1 and 2 on the eastern side of the east river at Pictou near the Indian Burying ground containing 280 acres and 70 acres in an after division containing in the whole 350 acres...

Crown Grant to James McPherson (?) R: 1803 Old Grant Book 20/102

...unto James McPherson 100 acres...

Comments: Old Plan 199 contains the dimensions of the McPherson grant. The Grant itself is registered in 1803 but no date is on the document regarding the execution date. This becomes somewhat mysterious given that James McPherson conveys this interest to Donald Campbell in 1784. The dimensions are 192 rods southerly thence 100 rods easterly, thence 140 rods northerly to the shore thence along the various courses along the shore to the place of beginning.

Major Paul and Sapier to James Carmichael (1784) R: 1802: B: 2/137

We Major Paul and Sapier the two Indian Chieftains of the Pictou Tribe for ourselves and in name of the other Pictou Indians for a certain sum of money now paid to us by Mr. James Carmichael, make over to him and his heirs one acre of cleared lands less or more joining Indian Cross reserving the Burying Ground to ourselves given under our hand at Walemsly the Twenty Sixth day of August, 1784.

James McPherson to Donald Campbell (1784) R: 1804: B: 2/365

...beginning at a stake and heap of stones upon the bank of said harbour and its northwest corner and running from thence south 47 degrees east 192 rods thence south 43 degrees west 100 rods thence north 47 degrees west 140 rods until it reaches the bank of the said harbour thence the several courses of said harbour until the place of beginning, the whole whereof is laid out to contain 100 acres...

Walter Murray to James Carmichael (1785) R:1802: B: 2/155

...on lot number one of said east river of pictou bounded on the south by number two grant to James McKay on the north by the lot granted to James McPherson number 87 being in pictou harbour in the county of Halifax and Province of Nova Scotia containing by estimation 200 acres..."

Donald Campbell to Dugald McIntyre (1805) R: 1805: B 2/378

...beginning at James Carmichaels north line on the bank of the shore and running the several courses of the shore towards Donald Campbells south line 50 rods being one half of 100 acres granted me by James McPherson and to run the lines agreeable to the courses of the said deed from James McPherson to said Donald Campbell the whole whereof containing 50 acres...

Angus McIntyre to Richard Peacock (1810) R: 1810: B: 4/75

...laying between the land of James Carmichael and the late Donald Campbell and formerly purchased by the said Dugald McIntyre from the said Donald Campbell containing 50 acres...

Richard Peacock to Donald McGregar (1810) R: 1810: B: 4/76

...laying between the land of James Carmichael and the lands of Donald Campbell and formerly purchased by Dugald McIntyre deceased from the said Donald Campbell containing 50 acres...

Malcolm McGregor et al to Donald McDonald (1820) R:1828 B:12/74

...beginning on the shore of the east side of the harbour of Pictou at Fishers Grant aforesaid at the northmost corner of a lot in possession of said Donald McDonald thence south 48 degrees east to the land of our James Carmichael thence westwardly by the said James Carmichaels westwardly line to a pile of stones thence north 45 degrees west to the shore of the aforesaid harbour thence northeasterly along the course of the said shore to the place of beginning containing in the whole by estimation 47 acres...

James Carmichael to Isabella Fraser (1834) R: 1836 B: 18/336

...being *adjacent* to the Indian Cross so called, butted and bounded as follows beginning on the eastern shore of the Pictou harbour at the southern boundary of lands owned by Margaret McConnell and from thence to run southerly the various courses of the harbour 50 rods thence east until it meets the land owned by Margaret McConnell aforesaid thence to run west along the side line of Margaret McConnells' land until it meets the harbour of Pictou at the place of beginning and containing 100 acres...

James Carmichael to Margaret McConnell (1834) R: 1838 B: 21/72

...being at Indian Cross so called butted and bounded as follows beginning on the eastern shore of Pictou harbour at the southern boundary of lands owned by Donald McDonald and from thence southerly the various courses of the harbour until it meets the original boundary of the east river lots at a cold well on the edge of the marsh thence to run east until it meets the southern boundary of lands owned by Donald McDonald aforesaid thence to run north 5

degrees west along the said Donald McDonalds southern line until it meets the harbour at the place of beginning containing by estimation 34 acres be the same more or less; Also another certain tract of land abutted and bounded as follows beginning on the southern boundary of the above described lot of land on the eastern shore of the harbour at the cold well aforesaid from thence to run south 10 rods thence to run east until it meets the boundary of the 82nd grant thence to run north 45 degrees west along the boundary of the 82nd grant 14 rods thence to run west until it meets the harbour at the place of beginning containing 20 acres...

Donald McDonald to Daniel McDonald (4 P.O.-159-1860)

...I give and bequeath to Daniel my son 110 acres of my first farm at Fishers Grant...

...I give and bequeath to Catherine my daughter 65 acres of the south side of my lot of land at Fishers Grant...

Margaret McConnell to John Fraser (1867) R: 1867 B: 54/661

...being in Fishers Grant so called butted and bounded as follows beginning on the eastern shore of Pictou harbour at the southern boundary of lands owned by Donald McDonald and from thence southerly the various courses of the harbour until it meets the original boundary of the east river lots at a cold well on the edge of the marsh thence to run east until it meets the southern boundary of lands owned by Donald McDonald aforesaid thence to run north 5 degrees west along the said Donald McDonalds southern line until it meets the harbour at the place of beginning containing by estimation 34 acres be the same more or less; Also another certain tract of land abutted and bounded as follows beginning on the southern boundary of the above described lot of land on the eastern shore of the harbour at the cold well aforesaid from thence to run south 10 rods thence to run east until it meets the boundary of the 82nd grant thence to run north 45 degrees west along the boundary of the 82nd grant 14 rods thence to run west until it meets the harbour at the place of beginning containing 20 acres...

Robert Fraser to George Patterson (1870) R: 1871 B: 61/274

...being adjacent to the Indian Cross so called abutted and bounded as follows beginning on the eastern shore of the pictou harbour at the southern boundary of lands owned by John James Fraser esq. and from thence to run south 84 degrees east by the magnet 235 rods to the lands of a certain Daniel McDonald esq. thence south 39 degrees by the magnet 70 rods to lands owned by James McGregar esq. thence north 84 degrees west by the magnet 165 rods thence north 39 degrees west by the magnet 33 and one half rods thence north 84 degrees west by the magnet 80 rods by the lands of the above named James McGregar esq. until it comes to the eastern shore of Pictou harbour thence northerly by said shore to place of beginning containing 62 acres...

George Patterson to John Vaux (1876) R: 1876 B: 69/271

...being adjacent to the Indian Cross so called abutted and bounded as follows beginning on the eastern shore of the pictou harbour at the southern boundary of lands owned by John James Fraser esq. and from thence to run south 84 degrees east by the magnet 235 rods to the lands of a certain Daniel McDonald esq. thence south 39 degrees by the magnet 70 rods to lands owned by James McGregar esq. thence north 84 degrees west by the magnet 165 rods thence north 39 degrees west by the magnet 33and one half rods thence north 84 degrees west by the magnet 80 rods by the lands of the above named James McGregar esq. until it comes to the eastern shore of Pictou harbour thence northerly by said shore to place of beginning containing 62 acres...

Daniel McDonald to Elwood McDonald (1904) R: 1912 B: 162/306

...beginning at a point on the shore of the waters of Pictou harbour at the southwest corner of land belonging to the heirs of the late Catherine McDonald of South Pictou and running in a south easterly direction along said Catherine McDonalds lands and the line of lands of the heirs of the late William McKenzie until it comes to the line of lands of one James Ross thence in a south westerly direction until it comes to the Fishers Grant line thence along said Fishers Grant line until it comes to the north line of lands of John Vaux thence along the line of John Vaux's land to the waters of Pictou Harbour thence along the various courses of the shore to the place of beginning containing 150 acres...

Pictou Landing Band Council

Site 6, Box 55, RR # 2
Trenton, NS B0K 1X0
Phone: (902)752-4912
Fax: (902)755-4715

November 19, 2008

The Honourable Murray K. Scott
Minister of Transportation and Infrastructure Renewal
Province of Nova Scotia
Johnston Building
1672 Granville St.
P.O. Box 186
Halifax, Nova Scotia
B3J 2N2

-and-

The Honourable David Morse
Minister of Natural Resources
Province of Nova Scotia
3rd Floor, Founders Square
1701 Hollis Street
P.O. Box 698
Halifax, Nova Scotia
B3J 2T9

Dear Ministers:

Re: Boat Harbour Treatment Facility

On behalf of the Pictou Landing First Nation I would like to thank you for the opportunity to meet with you on November 7, 2008 and to discuss the impacts of the Boat Harbour effluent treatment facility on my People.

As you know, the effluent treatment facility is located near our reserve at Pictou Landing and currently treats effluent from the kraft pulp mill at Abercrombie Point. Boat Harbour is a former tidal lagoon adjacent to our reserve which was used extensively by our ancestors and many of us alive today for fishing, hunting, navigation and recreation prior to 1965. When the Province established the effluent treatment facility in 1965, Boat

Harbour was cut off from the Northumberland Strait by a control structure and has been used as a settling pond in the effluent treatment process ever since. As a result, Boat Harbour has become polluted with dioxins, furans, mercury and other hazardous substances and is unfit for human use and enjoyment. Airborne sulphur compounds from the effluent regularly drift over our homes, schools, playgrounds and beach causing a repulsive odor and leading to constant worry and concern for the health and well being of ourselves and our children.

We have lived with the effects of the effluent treatment facility for over 40 years. During this time we have been deprived of the use of Boat Harbour as a hunting, fishing and recreation area. Our community has been invaded by airborne contaminants. In the past the concentration of sulphur compounds in the air was so great it caused the paint to peel off our houses! As recently as two weeks ago a worried mother called our health officer and asked if it was safe to send her son to school because the smell of sulphur in the air was so bad. As a Mi'kmaq community we are relegated to our reserve and traditional resource area and, unlike others living in Nova Scotia, cannot simply sell our land and move elsewhere to avoid the effects of environmental contamination.

In 1965 when our Chief and elders were asked to consent to the establishment of the treatment facility at Boat Harbour they were concerned about the effects it would have on our People. Representatives from our community were taken by officials of the Province and shown an effluent treatment facility in New Brunswick. There was no apparent odor at that treatment facility and our leaders were advised that the Boat Harbour effluent treatment facility would likewise have no odor or adverse effects. Based on these representations, a Band Council Resolution was passed consenting to the project as it would be good for the economy of Pictou County. While the resolution had no legal effect, it does illustrate the good faith shown by our leaders and their consideration for the best interests of all residents of Pictou County. Of course, we know now that the effluent treatment facility has had devastating impact on our community and our lives. We have since discovered that the New Brunswick facility that our leaders were shown was not operational at the time they viewed it and our leaders had been deliberately misled about the effects that the Boat Harbour treatment facility would have on our community.

The Province operated the treatment facility from 1965 to 1995. From the outset our People protested the pollution of Boat Harbour as soon as the true state of affairs was known. In 1983 we pursued an action against Canada for breach of fiduciary duty for permitting the effluent treatment facility to proceed in the first place. A settlement was reached with Canada in 1993 and shortly afterward, in 1995, the Province made a commitment to close the treatment facility by December 31, 2005, to rehabilitate Boat Harbour and to remove the control structure so that Boat Harbour could be returned to tidal. It was at this time that the Province leased the Crown land on which the treatment facility was located to the mill owners and gave the mill owners a license to discharge

effluent into Boat Harbour. The mill owners have operated the effluent treatment facility ever since.

A few years after taking over the operation of the treatment facility, it appeared that the mill owners had made changes to the effluent treatment process that would allow effluent to be discharged directly from the treatment facility into the Northumberland Strait near the mouth of Boat Harbour by means of a pipeline around or underneath Boat Harbour. This would mean that Boat Harbour was no longer needed as a settling pond and could be cleaned up and returned to tidal even while the treatment facility continued to operate in its current location. As a result, our People entered into negotiations with the mill owners which resulted in a commitment by the mill owners to construct a pipeline to allow the effluent to bypass Boat Harbour and to close the treatment facility permanently in the year 2030. In exchange our People agreed not to protest the location of the treatment facility and its impacts upon us. At the same time, the Province said it would clean up Boat Harbour and return it to tidal by December 31, 2005 once the pipeline was built.

As December 31, 2005 approached it became apparent that the pipeline was not a feasible option and the owners of the mill approached our People once again and asked for more time to find an alternative to the pipeline which would allow the treatment facility to operate while at the same time allowing Boat Harbour to be cleaned up and returned to tidal. We agreed to this in the spirit of cooperation and extended the time to clean up and return Boat Harbour to tidal to December 31, 2008.

It has now become apparent that Boat Harbour will not be returned to tidal by December 31, 2008 and no other solutions have been identified which would allow this to happen while the treatment facility continues to operate in its current location. Even if such a solution were available our People's attitude has changed. The pollution of Boat Harbour and the stench coming from the effluent treatment facility have become a symbolic rallying point for members of our community who see it as a serious affront to our quality and way of life by the broader Nova Scotia community. There is a growing sense that enough is enough. We have born the burden of the treatment facility for over 40 years but have seen few, if any, of the economic benefits from its operation. Even if a technical solution is available, such as the pipeline to MacKenzie Head which was considered and rejected by the Province over 15 years ago, as stated in our meeting we no longer want the treatment facility in our back yard. We want it decommissioned and relocated.

Our position has changed over the past eight years in part because we have come to better understand the constitutional and treaty rights of our People as a result of key decisions from the Supreme Court of Canada interpreting the treaties signed by our ancestors many years ago. As well, the duty of provincial governments to consult with First Nations in respect of government action which may impact them has now been articulated by the Supreme Court of Canada, and recognized by the Province of Nova Scotia as part of the Made in Nova Scotia Process. There is an onus on First Nations to clearly identify the

negative impact that proposed government action might have on their rights in order for those rights to be considered by government and, where appropriate, accommodated.

In light of this, earlier this year we put the Province on notice that we believed that the proposed transfer of the Crown lease and license to discharge effluent into Boat Harbour from Neenah Paper to the current mill owners triggered the Province's duty to consult. At the same time, we agreed not to contest a temporary license issued to the new mill owners allowing them to discharge effluent into Boat Harbour until December 31, 2008. We did this to avoid interruption to the operations of the mill. We were pleased that the Province took our position seriously and agreed not to extend the license beyond December 31, 2008 without consulting with us first. Consultation took place, and continues to take place, at regular monthly meetings held at Pictou Landing with representatives of the Province, Canada and the mill owners.

As noted above, as a result of this consultation process, we have taken the position that the only solution which will accommodate our interests is the closure of the treatment facility and its relocation to another area. We know that our position places a substantial burden on the Province as there are many Nova Scotians dependent on the mill for their livelihood and the current state of the pulp industry does not lend itself to substantial investment by the private sector in a project such as this. Nonetheless, our People have shouldered a substantial burden for years and we must do the right thing now to protect our People and ensure the health and well being of our future generations.

It is our position that the continued discharge of effluent into Boat Harbour and the continued operation of the treatment facility interfere with our common law, constitutional and treaty rights to the use the water in Boat Harbour, to hunt and fish in and around Boat Harbour and to use Boat Harbour for recreation and navigation. We also believe that they interfere with our right to use and occupy our reserve land and other land over which we have aboriginal title, including the bed of Boat Harbour itself, the Crown land on which the treatment facility is situated and other land owned by our First Nation. We assert as a constitutionally protected right, the right to live on these lands free from dangerous and offensive pollutants.

We will continue to work with representatives of the Province to accommodate our interests. As a first step we propose that negotiations take place immediately for accommodations which would allow us to consent, on a without prejudice basis, to the continued operation of the treatment facility in the interim until it can be decommissioned and relocated elsewhere. This would allow for the uninterrupted operation of the mill. However, such consent would be contingent on an enforceable deadline for moving the treatment facility and enforceable time lines for the clean up and return of Boat Harbour to a tidal estuary. As well compensation for the continued use of Boat Harbour during the interim period would need to be fixed. We believe that such an interim agreement can be worked out by December 31, 2008.

Afterward we wish to negotiate with the Province for fair compensation for the past interference with our rights as set out above and for the continued monitoring of the environmental impacts of the treatment facility on our People. These issues need not be resolved before interim accommodation measures are put in place. However, we do look forward to discussing the appropriate forum and timeframe to address these larger issues in the near future.

I would like once again to express our gratitude for the personal interest that you have taken in our plight. You indicated when we met that you would like to arrange for other Ministers of the Provincial Cabinet to tour Boat Harbour and meet with us as you have done, perhaps even Premier MacDonald himself, so as to gain a first hand view of our situation. We would certainly welcome this opportunity should you be in a position to arrange it and would be more than happy to meet with the Premier, your colleagues and any other government officials you believe should participate.

We look forward to working with the Province to resolve this long outstanding grievance.

Yours very truly,

CHIEF ANNE FRANCIS-MUISE

BJH/
cc: Twila Gaudet, Consultation Liaison Officer,
Kwilmu'kw Maw-klusuaqn, Mi'kmaq Rights Initiative
Northern Pulp Nova Scotia Corporation
Department of Indian and Northern Affairs, Canada

NOVA SCOTIA
Transportation and Infrastructure Renewal
Office of the Minister

PO Box 186, Halifax, Nova Scotia, Canada B3J 2N2

December 4, 2008

Chief Anne Francis-Muise
Pictou Landing Band Council
RR #2, Site 6 Box 55
TRENTON, NS B0K 1X0

Dear Chief Anne Francis-Muise:

Re: Boat Harbour Effluent Treatment Facility

Thank you for coming to Halifax on December 2, 2008, to meet Ministers Morse, Baker and myself, with members of our staff, to discuss returning Boat Harbour to a tidal state and closing the Boat Harbour Treatment Facility.

We welcomed the opportunity to confirm, in a face to face meeting, among the leaders of both governments the Province's intention to end negative impacts on your community caused by the Boat Harbour Effluent Treatment Facility.

As Minister Baker so graphically stated: "To say that the Band has been long suffering would be a masterful understatement of the obvious." It is our unwavering intention to end that suffering as quickly as possible. It should have been done long ago.

Our first step will be to find another discharge location for mill effluent that does not involve Boat Harbour. We will then clean the harbour and return it to a tidal state.

Achieving our mutual goal of relocating the Boat Harbour Effluent Treatment Facility will take time to complete as there is a massive amount of work involved. The band has been incredibly patient with time expended on attempts so far.

In grateful response to the band's cooperative spirit we wish to make a contribution to the community recognizing the negative impact of delay in closing the facility from the intended completion date of December 31, 2008, to the final completion of this major task.

We have agreed that a committee consisting of the Chief of the Band and a Minister of the Province shall be created, with a first meeting in early January and to oversee the work necessary to achieve our mutual objective. You have expressed a willingness to consider what form this contribution might take before our first meeting.

. . . . 2

Prior to that meeting, our respective staff will work together to draft a Memorandum of Understanding (MOU) to lay out the objectives and terms of this plan. I propose that we also address the issue of timing in the MOU.

Let me make our government's position perfectly clear. We believe your community has suffered from the negative effects of the Boat Harbour Treatment Facility for far too long. We are fully committed to ending that suffering as quickly as it is practical to do so.

Your patience and cooperation in achieving this common goal are truly appreciated.

Sincerely,

Murray K. Scott
Minister

cc: Honourable David Morse, Minister of Natural Resources
Honourable Michael Baker, Minister of Aboriginal Affairs
Twila Gaudet, Consulation Liason Officer
Kwilmu'kw Maw'klusaqun, Mi'kmaq Rights Initiative
Northern Pulp Nova Scotia Corporation
Department of Indian and Northern Affairs, Canada

MI'KMAW CONSERVATION GROUP

THE CONFEDERACY OF MAINLAND MI'KMAQ

NORTHERN PULP EFFLUENT SPILL: MCG TEST RESULTS REPORT

Tuesday June 10, 2014

Prepared October 31st, 2014 for Pictou Landing First Nation

Report Prepared by:

Matt Lees, Water Resource Engineer, Mi'kmaw Conservation Group (MCG)
Sana Kavanagh, Research & Education Officer, Mi'kmaw Conservation Group (MCG)
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Report Prepared for:

Pictou Landing First Nation, Chief and Council

Acknowledgements:

Clayton Coppaway for his revisions on an early draft of this report.

Effluent and Water Samples Collected by:

Angeline Gillis, Kate Nelson, Jillian Saulnier, Christian Francis and Matt Lees, Mi'kmaw Conservation Group (MCG)

Disclaimer:

This document contains confidential information. This document is not to be used for legal purposes.

Contact (Please direct questions or comments to):

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Executive Summary

On Tuesday June 10, 2014 an effluent pipe at Northern Pulp Nova Scotia Corporation [NPR ID (815)] located at Abercrombie Point, Pictou, Nova Scotia ruptured. The Pipeline runs from the Mill under the East River, to the Boat Harbour Wastewater Treatment Facility. An estimated 4-5 million litres of raw effluent was released into the environment.

A visual assessment identified the source of the pipeline rupture and the pathway of the effluent as it flowed from the source, through a wetland and into the mouth of the East River. MCG staff collected soil and water samples along this pathway at four locations: the Pipe Break Source, the Wetland, the Pictou Beach, and the East River estuary. Water samples were tested for TSS, BOD, pH, E.Coli/coliforms, heavy metals, lead, and mercury. Soil samples were not analysed because the soil was saturated with effluent during the time of sampling and would likely have demonstrated similar results as the water samples. Concentrations of lead, mercury and pH levels where found highest at the source and decreased as the effluent reached the East River. The concentration of TSS was highest in the East River, likely due to waves and effluent stirring up sediment. The concentration of Carbonaceous BOD was found in the Wetland, likely attributed to high organic content present before the spill. A heavy metals analysis detected a diverse number of heavy metals. E.Coli and Total Coliform tests were invalid due to interfering substances and atypical colors.

Water samples collected from the four locations identified higher than acceptable production rates of pH, and BOD in accordance with the *PPER`s.* TSS production rates exceeded *PPER's* at the East River location but this was likely due to turbid water from waves and the flow of effluent. A heavy metal analysis, including lead and mercury, showed that the effluent contained a variety of heavy metals above the *Tier 1 Environmental Quality Standards for Surface Waters* for aquatic species. Nova Scotia Environments *Northern Pulp Effluent Leak Rest Results* identified that effluent was not acutely lethal. The report also identified the presence of chlorinated dioxins and furans, but no 2,3,7,8 structures which are to be non-detectable according to the *PPER`s.* Concentrations of BOD, TSS, and pH found by NSE varied from results found by MCG, but these differences may be explained by varying locations and time of sampling.

The contamination caused by the effluent in the area surrounding the ruptured pipeline may have negative impacts to terrestrial and aquatic ecosystems and species. The tide was coming in during the time the effluent pipe ruptured making it possible for contaminants to have traveled from the East River Estuary discharge point up to the East River. Sequentially, high tides that afternoon could have carried contaminants out toward the Northumberland Straight. The most significantly affected area appeared to be the Wetland because of the visually evident damage to vegetation and because wetlands are dynamic and productive ecosystems with many essential functions for potential wildlife and vegetation.

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1.0 Introduction

1.1 Background

Northern Pulp Nova Scotia Corporation [NPR ID (815)] operates a Kraft pulp mill located at Abercrombie Point, Pictou, Nova Scotia. The Kraft process is a multi-step chemical extraction procedure which involves adding sodium hydroxide (also known as caustic soda or lye) and sodium sulfide to wood chips (Northern Pulp Nova Scotia, N.D). These chemicals break down the wood, separating lignin and hemi-cellulose from the cellulose which is used for making paper (Northern Pulp, Nova Scotia Corporation, N.D). One strength of the Kraft mill process is that many of the chemicals used are recycled. For example, the sodium hydroxide and sodium sulfide used to break down wood is recovered and used again. Parts of wood that are not used for papermaking are simmered down into a thick liquid called "black liquor". Lignin, hemicellulose, sodium carbonate, and sodium sulfate form "black liquor" (Northern Pulp Nova Scotia Corporation, N.D). The black liquor is concentrated and then burned to generate electricity (Northern Pulp Nova Scotia, N.D). Despite this recycling, each stage of the Kraft process produces wastes. Liquid wastes (effluent) are created at several stages of the Kraft process. Types of effluent from Kraft mills include: causticizing effluent, puling effluent, paper machine effluent, evaporator foul condensates, digester foul condensates, and bleaching filtrates (Dusfresne and Laroche 1999). Pulp mill effluent is composed of complex mixtures of hundreds of compounds, many of which remain unidentified (Culp et. all, 2008). While the exact constituents of pulp mill effluent are often unknown, some characteristic effluent can be expected from the Kraft processes. When pulp is bleached at the Kraft mill, the effluent is referred to as Bleached Kraft Mill Effluent (BKME). The bleaching process leads to the formation of organochlorides.

Effluent from Northern Pulp is transported through a pipeline from the mill site, under the East River, to the Boat Harbour Wastewater Treatment Facility located in the Boat Harbour lagoon. The lagoon and treatment facility are located near the Pictou Landing First Nation Mi'kmaw Community on land owned by the Province. The mill has been treating the effluent at the Boat Harbour site since 1967. The effluent pipeline, treatment facility, and Boat Harbour's environmental condition have been a longstanding issue of dispute between the Pictou Landing First Nation and the Government of Nova Scotia, which owns the wastewater treatment facility. There has been plans in the past put-forth by the government to close boat harbor but historically they have fallen through.

1.2 Pipeline Rupture Event

On Tuesday June 10, 2014 the pipeline that runs between Northern Pulp Nova Scotia Corporation [NPR ID (815)] and the Boat Harbour Wastewater Treatment Facility ruptured resulting in point source pollution of untreated industrial effluent released into the nearby land and waterways. The pipeline transports an estimated 90 million liters of untreated effluent per day. The leak is believed to have started during the early morning hours around 7:00 am. During the presumed time the pipe ruptured on June 10th, the tide was coming in. High tide (1.7 meters) was estimated at 7:50am, thereafter, the tide went out till 2:40pm

(Low tide was 0.6 meters) (tides4fishing, 2014). An estimated 4 - 5 million litres of raw effluent was released into the environment which is equivalent to two Olympic sized swimming pools (2.5 million litres each). Environment Canada ordered Northern Pulp Nova Scotia Corporation [NPR ID (815)] to clean up the effluent, enforcing the *Fisheries Act*. A barricade was erected by Pictou Landing First Nations at the entry to the road leading to the site of the effluent leak. The barricade was in protest to the treatment and discharge of effluent in Boat Harbour and to ensure that mill officials consulted with the Pictou Landing Band Council about Mi'kmaq burial grounds located near the spill. Environmental consultants were allowed through the barricade to test for contaminants and develop a plan for remediation. Environment Canada, and other organizations were present to conduct site assessments. After the recent effluent leak and the protest, the Province has agreed to introduce legislation that will work towards closing treatment and remediating Boat Harbor. The Bill will be introduce by June 30th, 2015.

1.3 MCG Response

The Pictou Landing First Nation Chief and Council requested the presence of Mi'kmaw Conservation Group (MCG) staff at the site. On June 10th, 2014 MCG staff, Jillian Saulnier and Kate Nelson, went to the pipeline break site. They observed the pipeline break and effluent path from the pipe, through a wetland, across a beach, and into East River estuary. The next day (June 11th, 2014) MCG staff (Matt Lees, Jillian Saulnier, Angeline Gillis and Christian Francis), collected effluent, water, and soil samples which were sent to various laboratories for analysis.

1.4 Regulatory Summary

Northern Pulp's pipeline rupture on June 10th, and the long-term contamination of Boat Harbour, enacts various Federal and Provincial legislation and regulations. Provincially, the most relevant piece of legislation is Nova Scotia's *Environment Act*. The *Environment Act* regulates contaminated sites protocols, and wetland conservation (see Appendix A). *Contaminated Sites Protocol*s provide *Tier 1 Environmental Quality Standards for Surface Water* which lists safe concentrations for aquatic species for a variety of parameters in fresh and marine waters.

Effluent from the pulp and paper industry is regulated federally through the *Pulp and Paper Effluent Regulations* (PPER) under the *Fisheries Act,* and the *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations* under the *Canadian Environmental Protection Act (CEPA)* (EC, 2003). The PPER list three "deleterious" substances that are regulated: the Biological Oxygen Demand (BOD), Total Suspended Solids (TSS) and toxicity (to a sentinel species) of effluent (EC, 2003). Under the *PPER*, the Environmental Effects Monitoring Program (EEMP) also requires that mills monitor the effects of their effluent on the receiving environment and local aquatic biota (EC, 2003). The *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations* under *CEPA* prohibits the release of measurable 2,3,7,8 chlorinated dioxins and furans (EC, 2003).

1.5 Goals and Objectives

The goal of this report is to determine the potential impacts the raw effluent on the surrounding environment. This goal will be achieved by through the following objectives:

1. Identify constituents of the raw pulp effluent and their concentrations;
2. compare results from MCG's samples to those collected by other agencies to determine consistency; and,
3. review relevant legislation, regulations and quality standards to determine any exceedances.

2.0 Methodology

MCG staff first arrived on site to make visual assessments of the effluent leak and path of transport. A sampling approach was then structured as to provide a profile for the traveled path of the effluent and the respective contaminant concentrations along it. MCG staff members were able to make observations and collect water and soil samples using laboratory approved sample vials.

2.1 Observations

At the site of the effluent spill, there were several visual signs indicating the location at which the effluent pipe was ruptured. Near this site, the effluent had a sludge-like consistency and covered a large area of vegetation. Visual signs suggested that the effluent flowed downhill from the source of the pipe break, over a path, through a wetland area, onto a beach, and into the East River estuary. The path of the effluent was apparent due to flattened and discolored vegetation. There was also an eroded gully from the pipe to the beach, suggestive of the sudden release of large volumes of liquid. A tree had sunk into the hole where the pipe ruptured (See Figure 1). Brown effluent was observed flowing over a nearby path and pooling in wetland and beach areas (See Figure 2). From the wetland, the effluent overflowed across the beach and entered the East River estuary as shown (Figures 3-4).

The effluent had a strong odor. The strongest odor began a few hundred feet from the rupture site around to beach and wetland runoff. Mi'kmaw Conservation Group staff noted that the fumes were irritating to the nose and throat, and some staff reported developing headaches while at the site. A Nova Scotia Environment (NSE) Inspection Specialist stated that the flow and color of effluent had slowed down and was much clearer then when he was assessing the site at 11:00am that morning. Local residents stated that the effluent was seen all the way down to Melmerby Beach but was not directly observed by Mi'kmaw Conservation Group staff.

Figure 1: Pipe Rupture site. Note the blown down vegetation and the tree which had collapsed into a pool of effluent.

Figure 2: Wetland Location. Note the pooled effluent filling the wetland and browned vegetation

Figure 3: Flow from the Wetland onto the Beach. Note the blown down vegetation and color of the effluent.

Figure 4: Picture Flow from the Wetland into the East River Estuary. Note the signs of erosion along the effluent pathway.

2.2 Sample Locations

Sample locations were chosen at four sites that followed the effluent pathway. They began at the source of the ruptured pipe to the final discharge into the East River estuary. The sample locations were selected to provide concentrations along the untreated effluent pathway, intended to delineate a profile of contaminant transport from the source of the effluent (assumed point of highest concentrations) to the discharge into the East River estuary. A map of showing the location of the sample sites can be seen in Figure 3.5. These sites were labeled and will later be referred to as the following:

1. Site 1 (Pipe Break Source)
2. Site 2 (Wetland)
3. Site 3 (Pictou Beach)
4. Site 4 (East River)

Two water samples for each test were taken at each location for scientific accuracy, but only one sample was tested to avoid redundancies and reduce cost. Samples were collected by submerging the bottles in the water until full. Latex gloves, safety glasses and hip waders were worn during sampling to avoid contact with the raw effluent. Careful consideration was taken to not disturb the waterbed during sampling to avoid stirring up sediment.

Soil samples were taken from the Pipe Break Source, a woods area between the Source and the Beach, the Pictou Beach, and the East River. Soil samples were taken using a small hand spade and placed in a whirl pack (plastic bag). The spade was rinsed with bottled water between samples to prevent cross contamination between locations. Where applicable, a “wet” and “dry” soil sample was taken. The dry samples came from a slightly higher elevation than the wet samples where the effluent soaked soil had started to dry. This was intended to provide a sample more representative of the residual contaminants that would be left in the soil once the effluent had completely dried. Wet samples came from a lower elevation where the soil was still completely saturated with effluent. The wet samples were intended to provide a current state of soil contamination. A map of showing the location of the sample sites can be seen in Figure 5.

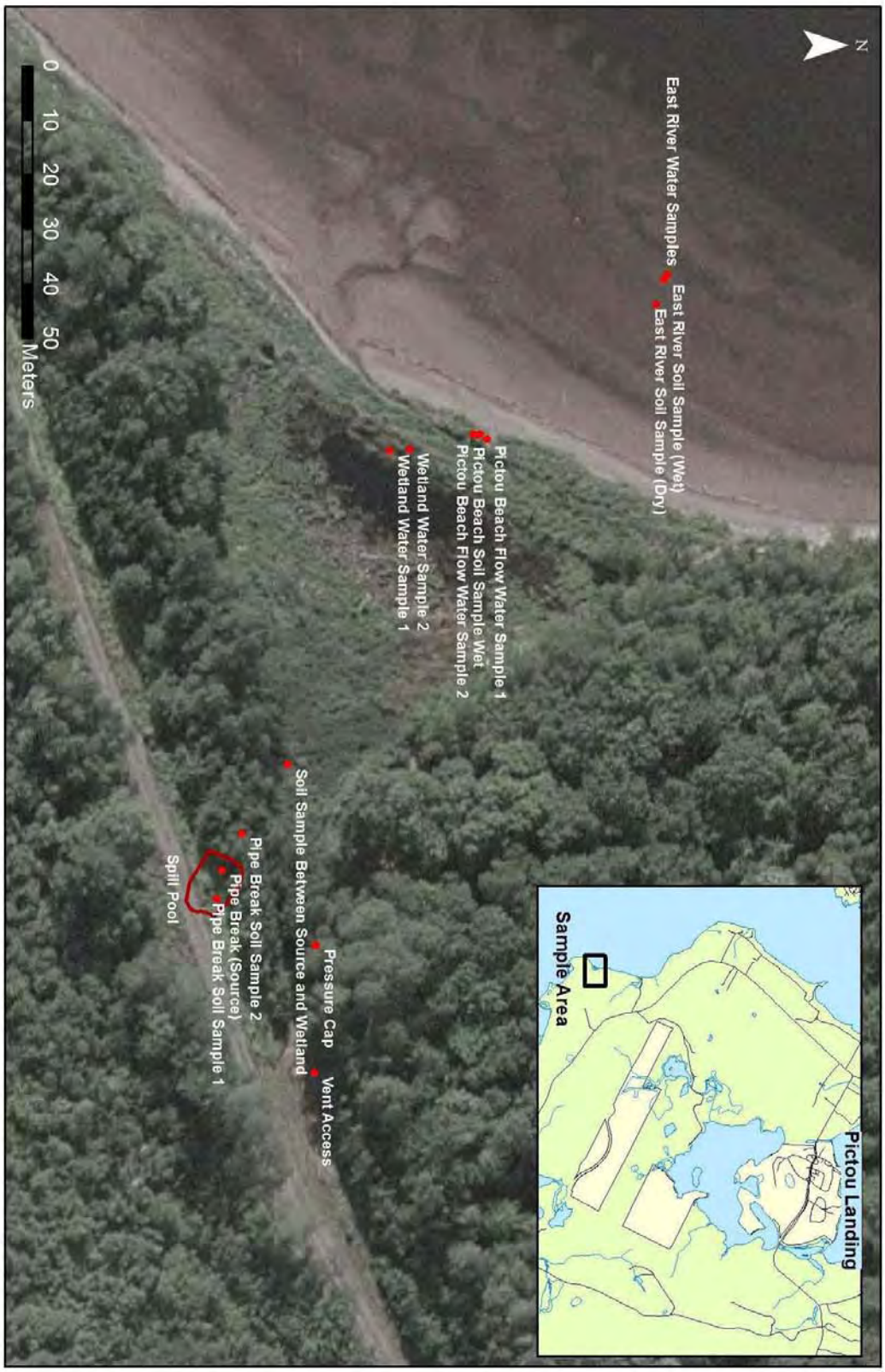

Figure 5: GIS Map of Sample Locations at the Site Northern Pulp Pipeline Break

2.3 Soil and Water Quality Analysis

Water samples were sent to three separate facilities: Maxxam Analytics, the Department of Agriculture, and the Aberdeen Hospital, soil samples did not undergo analysis. Water samples sent to Maxxam Analytics were tested for heavy metals, mercury and carbonaceous BOD. Samples sent to the Department of Agriculture were tested for total suspended solids (TSS), pH, and lead (also included in the heavy metals analysis done by Maxxam). The Aberdeen hospital samples were tested for total coliforms and E.coli. Water sample bottles specific to the parameters being tested were received from each facility. These parameters were chosen to be tested based on preliminary research on pulp mill effluent. The following metrics were chosen:

i. **pH** - a measure of how acidic or basic a substance is rated on a scale from 0 – 14, 0 being acidic and 14 being basic
ii. **TSS** – a measure of filterable solids suspended in water (Droste, 2012)
iii. **BOD** – a measure of the amount of oxygen required for biological decomposition of organic matter (EPA, 212b)
iv. **Dioxins and Furans** - a family of organochlorides typically produced as chemical by-products (HC; EC, 1990)
v. **Heavy Metals** (including lead and mercury) – metallic chemical elements that can be used as essential nutrients for life or can be very toxic in small amounts (U.S DOL, N.D)
vi. **Fecal Coliforms** – coliforms used as an indicator for the presence of fecal matter (EPA, 2014a)
vii. **E.coli** – harmful bacteria found in the intestines of warm blooded animals (EPA, 2014a)

All four sample locations (Sites 1, 2, 3, 4) were tested for lead, pH, total, coliform bacteria and E.coli. Only Site 1 (Pipe Break Source), Site 2 (Wetland), and Site 4 (East River) were tested for heavy metals, carbonaceous BOD, and mercury. Site 3 (Pictou Beach) was not sampled for the above mentioned parameters to avoid redundancies likely to be shown with Sample 2 (The Wetland) and to reduce the cost of analysis. It was surmised that Site 3 (Pictou Beach) samples would likely have shown similar results to Site 2 (Wetland) because it was located between the wetland and East River. TSS was tested for in the Wetland and East River samples. Table 1 shows a summary of the water quality analysis organized by sample location and the parameters tested by the respective facilities.

Table 1: Water Quality Analysis Summary by Site and Facility

Site	Location	Aberdeen Regional Hospital		Department of Agriculture			Maxxam Analytics			Total Collected
		Coliform Bacteria	E. coli	Lead	pH	TSS	Heavy Metals	Carbonaceous BOD	Mercury	
1	Pipe Break Source	✓	✓	✓	✓	×	✓	✓	✓	7/8
2	Wetland	✓	✓	✓	✓	✓	✓	✓	✓	8/8
3	Pictou Beach	✓	✓	✓	✓	×	×	×	×	4/8
4	East River	✓	✓	✓	✓	✓	✓	✓	✓	8/8

3.0 Results

The following section provides results found from water quality analysis from the three testing facilities (Maaxam Analytics, the Department of Agriculture, and the Aberdeen Hospital). Soil samples were not analysed, consequently, there are no soil quality results presented in this section.

3.1 Lead

Water samples were tested for lead by the Department of Agriculture and Maxxam Analytics. The highest concentration of lead was found at the Pipe Break site by both facilities; however, the Department of Agriculture's concentration of lead appears substantially higher than Maxxam's. The lead concentration declined as the sample sites moved further away from the site of the pipeline break and toward the East River estuary (See Figure 6). The Department of Agriculture had inconclusive data for the East River site. The Pictou Beach Site sample was not tested by Maxxam Analytics.

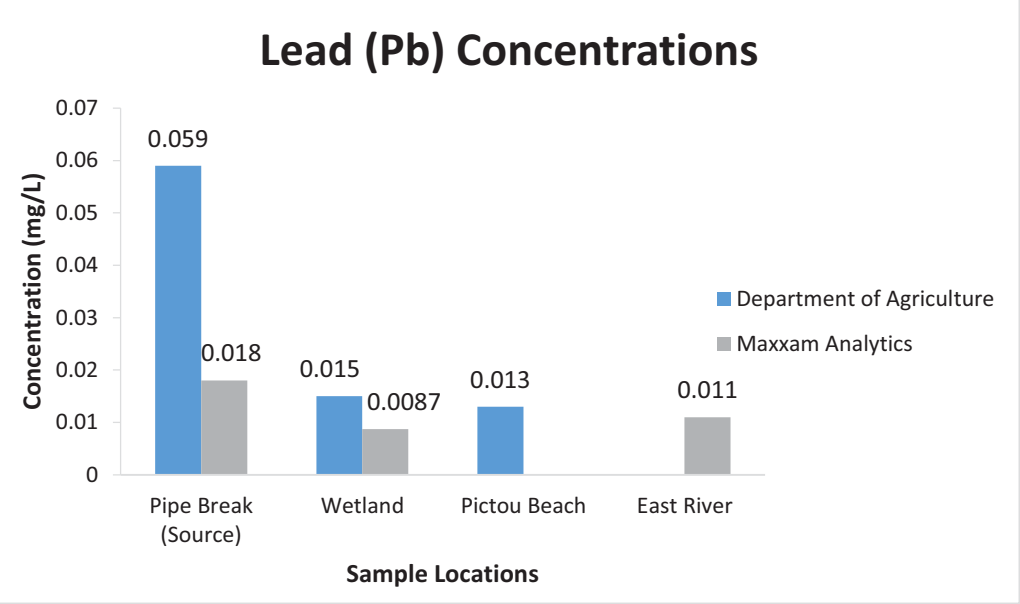

Figure 6: Lead (Pb) Concentrations along the Effluent Pathway from the Pipe Break Source to the East River

3.2 pH

Tests for pH were conducted solely by the Department of Agriculture. The pH level at the Pipe Break Source was found to be the highest (most basic). Levels of pH declined (increased in acidity) gradually as sample locations moved away from the source and toward the East River. The Pictou Beach and East River locations had a very similar pH levels (Figure 7).

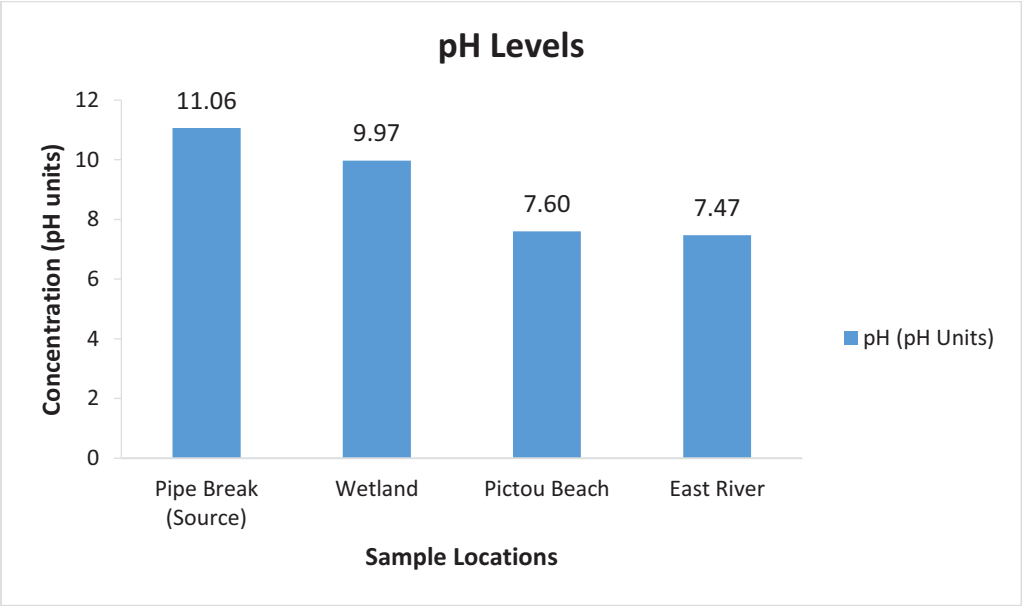

Figure 7: pH Levels along the Effluent Pathway from the Pipe Break Source to the East River

3.3 Total Coliform/E. coli

Samples from all four locations were sent to the Aberdeen Regional hospital to be tested for total coliforms and E. coli. The tests were invalid due to interfering substances in the water and atypical colors of the samples.

3.4 Mercury

Water samples were sent to Maxxam Analytics to be tested for mercury. The highest mercury concentration was measured at the Pipe Break Source. Mercury concentrations decreased as the sample sites moved further away from the source and toward the East River (Figure 8). The Pictou Beach sample was not tested to reduce cost and redundancies with the Wetland site.

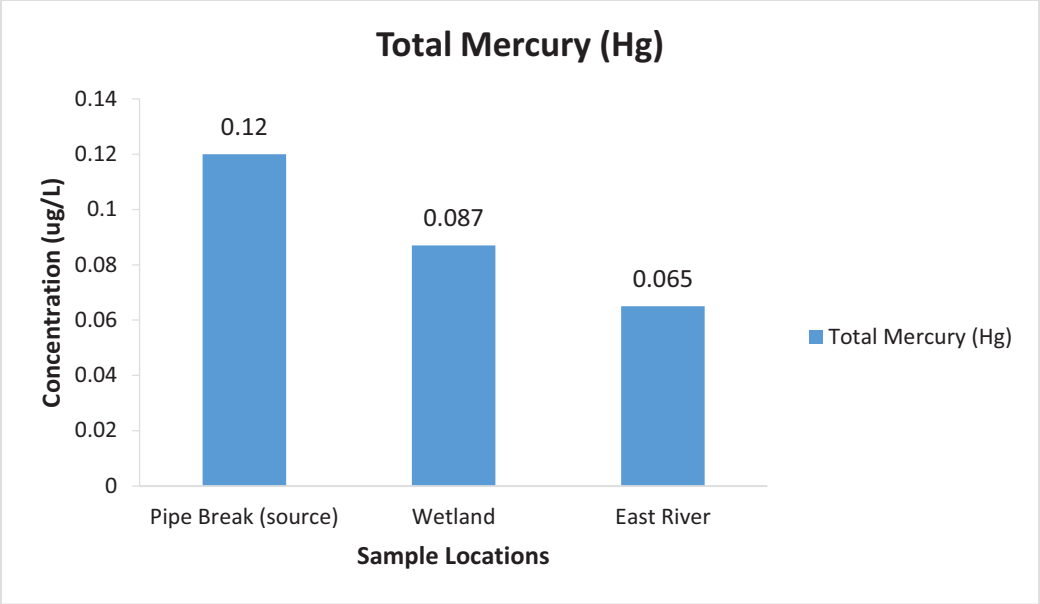

Figure 8: Mercury Concentrations along the Effluent Pathway from the Pipe Break Source to the East River

3.5 Total Suspended Solids (TSS)

Water Samples were sent to the Department of Agriculture to be tested for TSS. The highest concentration was measured at the East River site followed by the Wetland (see Figure 9). The source was not tested for suspended solids because there were a limited number of sample bottles. Priority was given to sample the Wetland and the East River. Concentrations at the site of the Pipe Break Source would not likely be representative of effluent concentrations as there was a lot of particulate matter in the water from the surrounding dirt and sludge and there would be no data in the case of future monitoring to compare this too because the effluent was going to be pumped out. The Pictou Beach sample was not tested to reduce cost and redundancies with the wetland site.

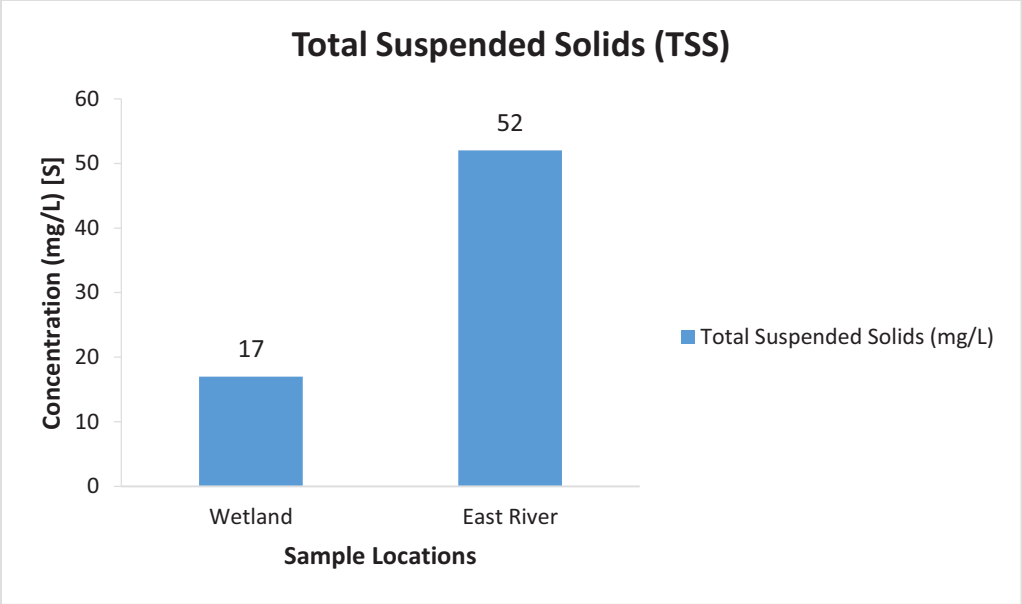

Figure 9: Total Suspended Solids (TSS) Concentrations at the East River and Wetland Sites

3.6 Carbonaceous Biological Oxygen Demand (BOD)

Carbonaceous BOD was measured by Maxxam Analytics. The highest concentration of BOD was measured at the Wetland followed by the Pipe Break Source with only 10mg/L separating the two. The East River had the lowest measured BOD concentration. The Pictou Beach sample was not tested to reduce cost and redundancies with the Wetland site (See Figure 10).

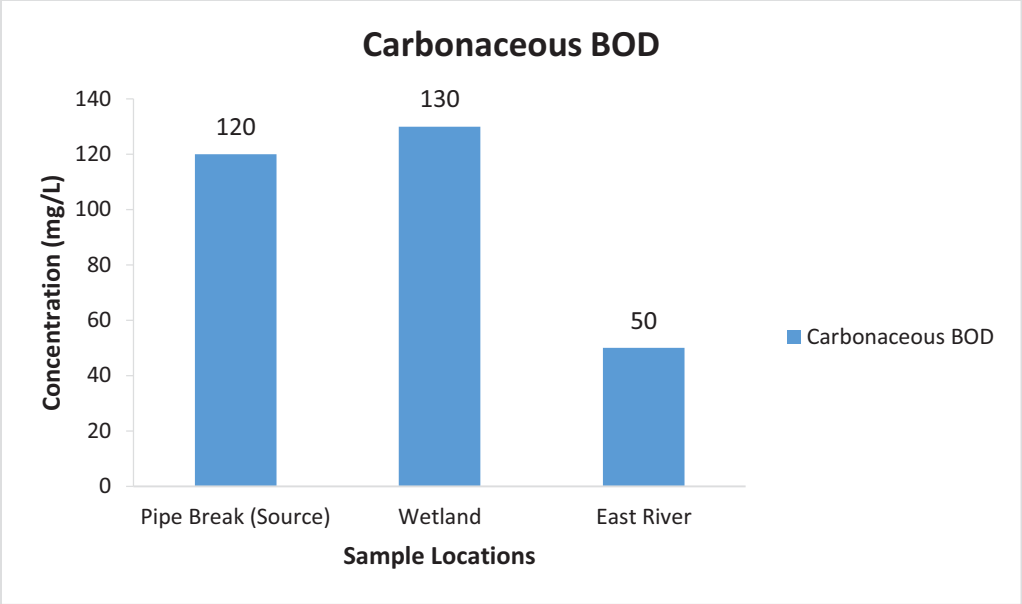

Figure 10: Carbonaceous BOD Concentrations along the Effluent Pathway from the Pipe Break to the East River

3.7 Heavy Metals

Table 2 shows a complete list of heavy metals tested by Maxxam Analytics and the concentrations measured at the Pipe Break Source, the Wetland and the East River. The Pictou Beach sample was not tested to reduce cost and redundancies with the Wetland site. There was no detection of Total Tin (Sn), Total Antimony (Sb), Total Beryllium (Be) or Total Bismuth (Bi).

Table 2: Heavy Metals Concentrations along the Effluent Pathway from the Pipe Break to the East River

*ND – Not detected

Metals (ug\L)	Site #1 – Pipe Break Source	Site #2 - Wetland	Site # 4 - East River
Total Aluminum (Al)	12000	2200	820
Total Antimony (Sb)	*ND	*ND	*ND
Total Arsenic (As)	9.9	6	7.8
Total Barium (Ba)	220	150	310
Total Beryllium (Be)	*ND	*ND	*ND
Total Bismuth (Bi)	*ND	*ND	*ND
Total Boron (B)	69	72	830
Total Cadmium (Cd)	0.89	1.1	0.53
Total Calcium (Ca)	17000	21000	99000
Total Chromium (Cr)	11	3.5	2.1
Total Cobalt (Co)	8.1	1.6	2.2
Total Copper (Cu)	37	11	13
Total Iron (Fe)	9800	2100	2300
Total Lead (Pb)	18	8.7	11
Total Magnesium (Mg)	2400	2400	200000
Total Manganese (Mn)	1100	790	3100
Total Molybdenum (Mo)	82	100	37
Total Nickel (Ni)	17	6.9	5.3
Total Phosphorus (P)	750	1000	410
Total Potassium (K)	8400	12000	66000
Total Selenium (Se)	2.8	6.8	2.4
Total Silver (Ag)	0.19	0.18	*ND
Total Sodium (Na)	210000	320000	1800000
Total Strontium (Sr)	37	63	1300
Total Thallium (Tl)	0.24	0.5	0.11
Total Tin (Sn)	*ND	*ND	*ND
Total Titanium (Ti)	110	25	15
Total Uranium (U)	2	1.2	1.9
Total Vanadium (V)	16	7.5	7.5
Total Zinc (Zn)	72	78	26

4.0 Discussion

It is a challenge to determine the effluents impacts on the local environment because of the ambiguity regarding the exact contents of the untreated effluent and lack of baseline environmental conditions. This was also the first time MCG staff had responded to conduct an emergency assessment of potentially hazardous contaminants. For these reasons, there are several uncertainties regarding sampling procedures and the consistency of data collected. Despite these limitations, MCG can make inferences on the composition and impact of the raw effluent released into the environment.

The following sections highlight uncertainties in the results from the water quality analysis, describes potential impacts on the environment, and identifies any legislative or regulatory breeches. Careful consideration was taken by MCG staff while collecting samples, but there are potential sources of error and variations in results. Soil samples were not chosen for analysis because they were saturated with effluent during the time MCG collected samples (even dry samples were soaked with effluent) and would likely have provided similar results to the water samples collected at the respective locations. To avoid redundancies and reduce cost of analysis, soil samples were not tested.

4.1 Water Quality Analysis

4.1.1 Lead

Lead concentrations were inconsistent between samples analysed by Maxxam Analytics and the Department of Agriculture. Variations in results from the two facilities could be explained from alternate methods of analysis with different accuracies. Samples sent to the two facilities were also collected separately which could explain why the lead concentrations were inconsistent. *Contaminated Sites Protocol*s provide *Tier 1 Environmental Quality Standards for Surface Water* lists safe concentrations for aquatic species for a variety of parameters in fresh and marine waters. According to these standards, lead concentration should be 0.002 mg/L for marine waters, and 0.001 mg/L for fresh water resources. Lead concentrations for all four sample locations exceeded these standards.

Lead is classified as a toxic substance, regulated under the Canadian Environmental Protection Act (CEPA, 1999) Small amounts of lead can be harmful to humans and wildlife (US EPA, 2011). . Lead is also bio-accumulative, which means it accumulates in organisms and persists in the food chain (EPA, 2011). Currently, the main exposure to lead for Canadian adults is through drinking water and food (HC, 2013). Paper and pulp mill effluent is a major source of lead released into water; this industry is estimated as the second largest contributor of Lead to the Canadian environment (EC, 2003).

4.1.2 pH

The effluent at the Pipe Break Source was found to be basic with a pH of 11.06. As the effluent traveled towards the East River pH levels declined, likely attributed to dilution stemming from the Wetland and East River. According to the NSE's *Northern Pulp Effluent Leak NSE Test Result**s*** (2014a)***,*** the approval rate for pH levels in Northern Pulp's effluent is between 6 and 9. The Pictou Beach and East River samples were within these standards. The Pipe Break Source and Wetland samples exceeded the approval rates showing pH levels above above 9.

The Environmental Protection Agency (EPA) states that pH can affect water's chemical and biological processes. Different aquatic species require various levels of pH in order to survive, therefore, variations in pH may have adverse effects on aquatic species (EPA, 2012a). Species at different stages of maturity will also have varying tolerances to pH levels. For example, in Atlantic salmon, fry experience higher mortality rates at lower pH levels than Parr and smolts (Farmer, 2000).

4.1.3 Total Coliforms/E. coli

Total Coliforms and E.Coli were chosen for analysis to determine if there was any sewage being directed into the plants effluent treatment rather than the municipal wastewater treatment. The tests were invalid due to interfering substances in the water and atypical colors of the samples.

4.1.4 Mercury

Mercury measured at the source of the effluent spill represents the levels found in the raw effluent (assuming the surrounding soil had no naturally occurring mercury levels). Mercury concentrations decreased as the effluent moved toward the East River, becoming more diluted. The *Environmental Quality Standards for Surface Waters* identified safe concentrations of mercury for aquatic species should be 0.016 mg/L for marine waters and 0.026 mg/L for fresh water resources. All measured mercury concentrations were above these standards.

Mercury is considered a toxic substance and can have serious impacts at low concentrations on aquatic and terrestrial ecosystems. In the form of methyl mercury, it can be transferred to higher order species through bioaccumulation (EC, 2013). Mercury can impact wildlife in a variety of ways including mortality, reduced fertility, slower growth and development, and abnormal behavior (EPA, 2014b). Mercury can also impact the endocrine system in aquatic species which effects development and reproduction (EPA, 2014b)

4.1.5 Total Suspended Solids

Samples for TSS were collected at the Wetland and the East River; a higher concentration of TSS was measured at the East River. Waves and tidal activity at the sample location near the shore could have

stirred up sediment causing excessive turbidity making the sample un-representative of the effluents concentration. Using the measured concentrations of TSS, the production rates were calculated based on Northern Pulp's effluent flow rate (90,000,000 L/day). Calculations are shown in Appendix B. The *PPER's* regulate the TSS production rate based on the plants overall production rate. According to NSE's *Northern Pulp Effluent Leak Results* (2014a), the approval TSS production rate for the plant is 4,100 kg/day. TSS in the Wetland was below this rate though the East River sample exceeded it, Table 3 shows a regulatory comparison. The Wetland site proceeded the East River site so the assumption can be made the concentration of TSS in the raw effluent was not the cause of the higher turbidity at the East River site. It is more likely that the higher TSS at the East River was caused by the flow of the effluent itself stirring up particulate matter from the ground, and waves crashing on shore stirring up sediment.

Elevated TSS can have negative impacts on aquatic plant and animal species. Turbid water can reduce the amount of light transmittance through the water which can have adverse effects aquatic plant causing disruptions to photosynthetic processes and reducing food availability for fish. High levels of suspended sediment can clog fish gills, affect swimming, and reduce visibility in fish (particularly affecting sight feeders) (Robertson et all, 2006). Diminished habitat quality has the most significant impacts on spawning grounds (Robertson et all, 2006).

Table 3: TSS Production Rate Regulatory Summary

Production Rate Approval (kg/d)	Calculate BOD Production Rates (kg/d)	
	Wetland	East River
4,100	1,530	4,500

4.1.6 Carbonaceous BOD

The BOD concentration was highest in the Wetland, followed by the Pipe Break Source and then the East River site. The BOD concentration at the source of the effluent spill was intended to be representative of the organic content in the pulp waste. The Wetland showed a higher concentration of BOD than the Source, which may be attributed to naturally higher levels of organic material already present, though the pulp effluent may have elevated these levels. Using the measured concentrations at each sample location and Northern Pulp's effluent flow rate (90,000,000 L/day), the production rates of BOD were calculated (see Appendix B). The *PPER's* regulate the BOD production rate based on the plants overall production rate. According to NSE's *Northern Pulp Effluent Leak Results* (2014a), the production approval requirement for Northern Pulp is 3960 kg/day. The calculated BOD production rates for both sample locations exceeded the approval requirement. Table 4 shows a regulatory comparison of production rates.

If oxygen is consumed at a higher rate than the atmosphere can reaerate the water, then the amount of dissolved oxygen (DO) in the water will decline. Declining DO levels can have adverse effects on aquatic

plant and animal species which require certain levels of dissolved oxygen to survive. Low DO can cause avoidance, weakness or death in fish. Overall water quality will decline with DO causing poor aesthetics such as odor, high turbidity, reduced water levels and discoloration. (EPA, 2012b)

Table 4: BOD Production Rate Regulatory Summary

Production Rate Approval (kg/d)	Calculate BOD Production Rates (kg/d)		
	Pipe Break Source	Wetland	East River
3960	10,800	11,700	4,500

4.1.7 Heavy Metals

A complete heavy metals analysis was conducted to provide insight into any unknown constituents in the raw effluent. The majority of the heavy metals were detected except for Total Tin (Sn), Total Antimony (Sb), Total Beryllium (Be) and Total Bismuth (Bi). Metals detected at the Pipe Break Source are intended to be representative of the raw effluent. Metals that are found only in the raw effluent should show the highest concentrations at the Pipe Break Source and decrease as the effluent reaches the East River with dilution; however, some metals showed elevated concentrations at the Wetland and East River. These elevations may be explained by naturally occurring heavy metals at these locations. For example, the highest concentration of phosphorus was found in the Wetland, likely because of heavy vegetation and plant nutrient cycling that naturally occurs at that site. Total concentrations of barium, boron, cobalt, nickel, strontium, thallium, and uranium all fell below the *Tier 1 Environmental Quality Standards for Surface Waters* at all three measured sample locations (Pipe Brake Source, Wetland, and East River) for both fresh and marine waters. All other heavy metals exceeded these standards for at least one location. See Appendix C for a complete heavy metal comparison to the *Environmental Quality Standards for Surface Waters.*

Heavy metals are naturally occurring substances that can be found in water, the type and concentration of which varies based on the land's geology. Some metals can be used as essential nutrients while others can be very toxic in miniscule amounts. When the metals are at toxic concentrations they can have serious impacts on aquatic organism's survival, reproduction and behavior (EPA, N.D).

4.2 Nova Scotia Environment Northern Pulp Effluent Leak Test Results

The Nova Scotia Department of Environment (NSE) released test results from Northern Pulp's raw effluent spill sample on July 11, 2014. NSE tested for BOD, TSS, pH, acute toxicity, dioxins and furans. Samples were taken from three locations: the Wetland, the East River Discharge Point, and Melmerby Beach. It was found that the production rate of TSS and BOD, calculated based on measured concentrations, were higher than the plants approval rate in the Wetland. TSS exceeded the approval rate in the East River

discharge point. An acute toxicity test showed that the effluent was not toxic at the Wetland; lab errors affected the analysis of the other two sample locations. It was concluded by NSE that these sites would be more diluted than the Wetland because they proceeded it, making them non-toxic. The pH levels at all sample sites fell within the acceptable range (6-9). Dioxins and Furans were detected but there was no presence of 2,3,7,8 TCDD/TCDF. Chlorinated 2,3,7,8 structures of dioxins and furans are extremely toxic to mammals, causing death from exposure with as little as one microgram to a few milligrams per kilogram of body weight (HC, 1990). These structures can also accumulate in the fatty tissue of animals, and have been linked to cancer in humans (HC, 1990). It was mentioned in the report that effluent likely did not reach the Melmerby Beach. The Wetland and East River are two common sample locations between MCG and NSE. Common tests are compared in Figures 11 through Figures 13.

The Wetland showed similar concentrations of BOD for both MCG and NSE; MCG's sample had a higher concentration. MCG's BOD measurement was significantly higher at the East River location. Differences in the exact sample locations could cause the variance in concentrations. The surface area of the Wetland was large and samples taken from different areas may vary in concentration. MCG and NSE both collected a sample from the East River, but this is a very large area and actual sample locations could vary. MCG collected samples in East River's estuary close to the shore near the effluent discharge (See Figure 11), but NSE may have collected samples elsewhere. MCG and NSE likely collected samples at different times which could affect the concentrations attributed to factors such as effluent flow rate, settlement, and tidal activity.

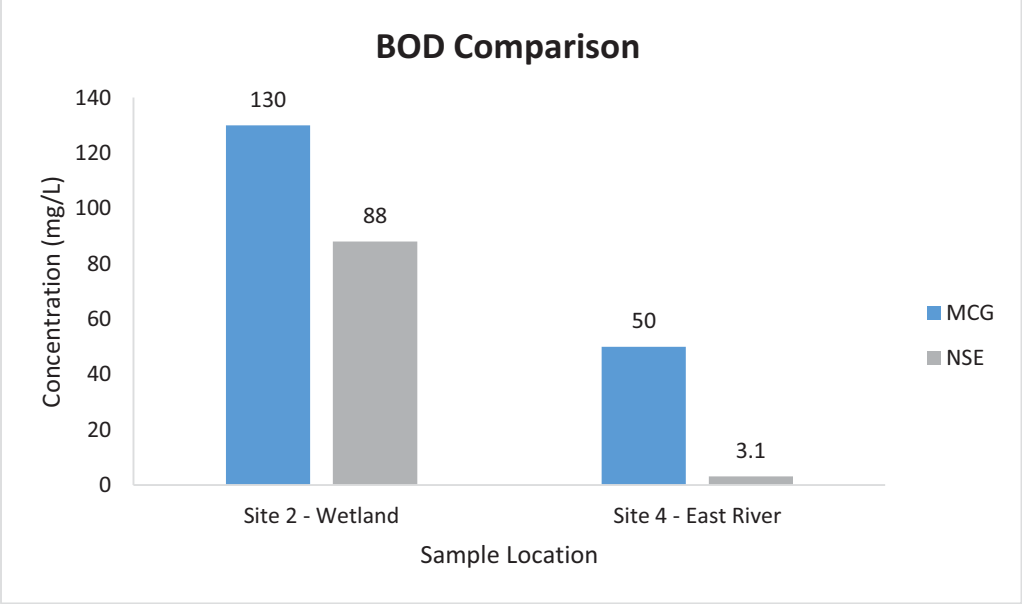

Figure 11: BOD Sample Comparison between MCG and NSE at the Wetland and East River Sample Locations

The TSS concentration measured by NSE at the Wetland was significantly higher than the MCG sample with a difference of 65 mg/L. The East River samples are more comparable with 13 mg/L separating the

two. The MCG Wetland sample was located in the middle of the wetland near its edge. The time in which the TSS samples were taken may affect the concentration because the longer the effluent remains in the Wetland, the more time particulate matter has to settle. TSS concentrations measured at the East River location, similar to the Wetland, may vary with the sample location. It should be noted that during the time MCG Sampled waves reaching the shore could have stirred more particles into the water column, potentially increasing the suspended particles present in the water. Figure 12 shows a comparison of MCG's and NSE's TSS sample results.

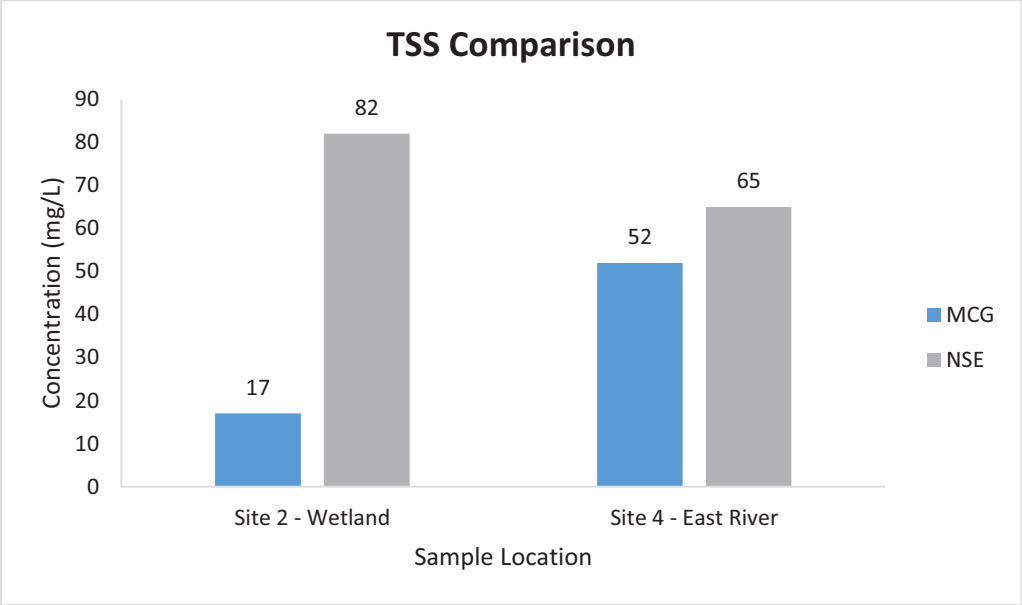

Figure 12: TSS Sample Comparison between MCG and NSE at the Wetland and East River Sample Locations

The pH levels measured by MCG at the Wetland were higher than NSE's. Samples collected at the East River were comparable. The time and location in which the samples were taken could explain the difference in pH. Figure 13 shows a comparison of pH measured by MCG and NSE.

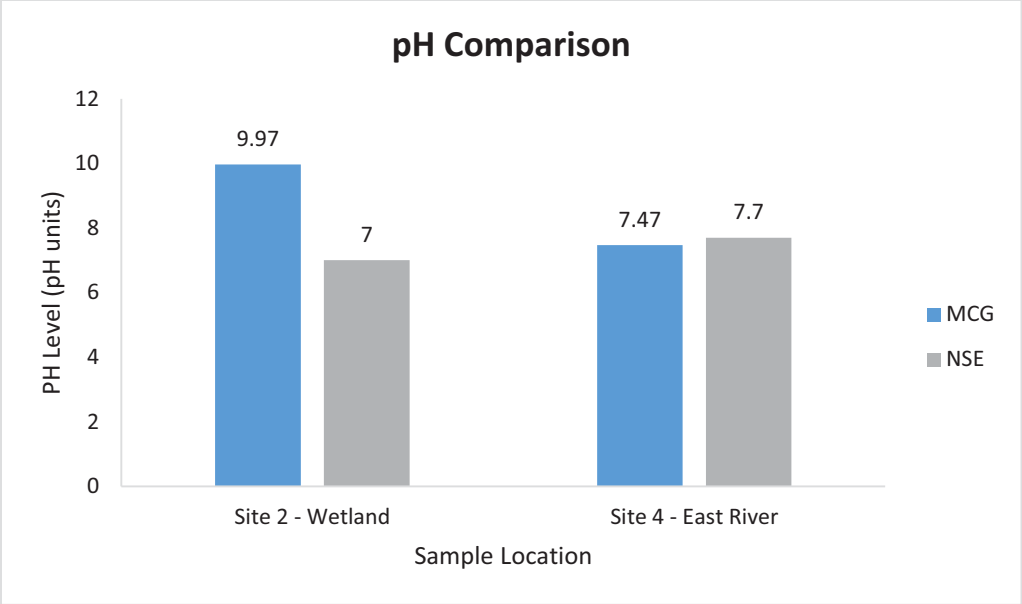

Figure 13: PH Sample Comparison between MCG and NSE at the Wetland and East River Sample Locations

4.3 Impacts by Location

Samples at the source of the effluent leak (the Pipe Break Source) were intended to show the point of highest concentration for any contaminants originating from the raw effluent. As the effluent traveled from the source towards the East River it was assumed the effluent would become diluted by water or adhere to the soil. Levels of PH, mercury and lead among many other heavy metals demonstrated the highest measured concentrations at the source. Soil and vegetation at the source will likely retain many residual contaminants.

The most significant impact resulting from the effluent leak appears to be the damage to the Wetland. Large quantities of effluent pooled in the Wetland causing it to overflow. The visual assessment identified dead large areas of dead and blown down vegetation. According to NSE (2014b), wetlands are one of the most productive and dynamic ecosystems. The loss of a wetland could have negative impacts on local fish populations, wildlife and the vegetation they depend on for food (NSE, 2014b). Wetlands also provide many useful functions such as water quality improvement, flood control, groundwater recharge, and provide habitats for endangered species (NSE, 2014b).

Effluent flowing into the mouth of the East River Estuary may have negative impacts to aquatic species. At the immediate point of effluent discharge into the East River, there were higher than acceptable concentrations of contaminants. During the presumed time of the pipeline rupture, the tide was coming in, potentially flushing contaminants into the East River. Sequentially, high tide that afternoon could have transported effluent into the Pictou Harbor and Northumberland Straight. It should be noted however that water from the estuary would significantly dilute the raw effluent.

5.0 Conclusion and Recommendations

5.1 Conclusions

On June 10th, Northern Pulp Nova Scotia Corporation's effluent pipe ruptured and released raw effluent into the surrounding area, causing potential threat to the health of the surrounding environment and wildlife. MCG staff tested for parameters that would provide some insight into the effluents composition and environmental impact. MCG`s water sample results showed the effluent was composed of higher than acceptable levels of pH, and BOD for production rates in accordance with the *PPER`s.* A heavy metal analysis, including lead and mercury, showed that the effluent contained a variety of heavy metals, many of them above the *Tier 1 Environmental Quality Standards for Surface Waters* for aquatic species. In summation, Federal (Fisheries Act and CEPA) and Provincial (the Environment Act) standards have been exceeded for pulp effluent and environmental water quality.

The most significant impact resulting from the effluent leak appears to be the damage to the Wetland because of its many beneficial and essential functions. Large quantities of effluent pooled in the Wetland causing it to overflow, blowing down and killing vegetation. At the immediate point of effluent discharge into the East River there were higher than acceptable concentrations of contaminants, but the effluent will become diluted as it is flushed throughout the estuary.

5.2 Recommendations

Several recommendations can be made regarding the management and future monitoring of the contaminated areas surround the site of the effluent leak. The *Environment Act* oversees the *Contaminated Sites Protocols Oder* and the *Contaminated Sites Regulations* (see Appendix A). The *Contaminated Sites Regulations* reference the use of the Canadian Council of Ministers of the Environment (CCME) documents that provide a National Classification System for contaminated sites. The CCME Guidelines for contaminated sites provides "a method for evaluating contaminated sites according to their current or potential adverse impact on human health and the environment" (CCME, 2008); however, in order for these to be enforced, the pipe burst site, surrounding area, and Boat Harbour will need to be listed as a contaminated site.

The management of this contaminated site is the responsibility of Northern Pulp and the agency hired to conduct the remediation, though several recommendations can be made for future sampling and monitoring surrounding of the site. Moving forward, MCG should develop a protocol for emergency response sampling for events similar in nature in the case this type of study is required again. Soil samples should be collected in the future to determine any residual contaminants. Water samples should be taken and compared to data established upon the time of contamination. Local fish populations should be monitored to ensure there are impacts on aquatic species. The loss of vegetation in the surrounding area, and loss of the Wetland may have negative impacts on local wildlife. The presence and populations of

wildlife prior to the leak may be established so impacts to these species can be monitored. The conditions of the Wetland prior to the effluent leak should be established to determine the extent of the damage.

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Appendix A – Regulatory Summary

Federal Environmental Legislation

- Canadian Environmental Protection Act (CEPA). 1999.
- Fisheries Act

Environment Act (Nova Scotia) – Drinking Water and Wastewater Regulations

- Water and Wastewater Facility Regulations
- Activities Designation Regulations
- Approvals Procedure Regulations
- On-Site Sewage Disposal Systems Regulations
- Well Construction Regulations.
- Nova Scotia Wetland Conservation Policy

Relevant Provincial Environment Regulations in Environment Act

- Environmental Emergency Regulations made under Sections 74, 136 and 171 and subsection 122A(3) of the Environment Act S.N.S. 1994-95, c. 1 O.I.C. 2013-17 (January 22, 2013), N.S. Reg. 16/2013
- PCB Management Regulations made under Section 84 and other regulation making Sections of the Environment Act S.N.S. 1994-95, c. 1 O.I.C. 95-291 (April 11, 1995), N.S. Reg. 52/95 as amended by O.I.C. 97-747 (December 2, 1997), N.S. Reg. 163/97

Contaminated Site Assessment

- Contaminated Sites Protocols Order made under clause 8A(1)(c) and Section 90 of the Environment Act S.N.S. 1994-95, c. 1 N.S. Reg. 244/2013 (July 3, 2013, effective July 6, 2013)

- Contaminated Sites Regulations made under clause 25(1)(g) and Section 91 of the Environment Act S.N.S. 1994-95, c. 1 O.I.C. 2012-60 (March 6, 2012, effective July 6, 2013), N.S. Reg. 64/2012

Appendix B – Production Rate Calculations

TSS Production Rate at Wetland (Eq. 1)

$$17\frac{mg}{L}TSS * 90{,}000{,}000\frac{L}{d} * \frac{1\ kg}{1{,}000{,}000\ mg} = 1{,}530\frac{kg}{d} \qquad (Eq.1)$$

TSS Production Rate at East River (Eq.2)

$$52b\frac{mg}{L}TSS * 90{,}000{,}000\frac{L}{d} * \frac{1\ kg}{1{,}000{,}000\ mg} = 4{,}680\frac{kg}{d} \qquad (Eq.2)$$

BOD Production Rate at Pipe Break Source (Eq.3)

$$120\ \frac{mg}{L}BOD * 90{,}000{,}000\frac{L}{d} * \frac{1\ kg}{1{,}000{,}000\ mg} = 10{,}800\frac{kg}{d} \qquad (Eq.3)$$

BOD Production Rate at Wetland (Eq.4)

$$130\frac{mg}{L}BOD * 90{,}000{,}000\frac{L}{d} * \frac{1\ kg}{1{,}000{,}000\ mg} = 11{,}700\frac{kg}{d} \qquad (Eq.4)$$

BOD Production Rate at East River (Eq.5)

$$50\frac{mg}{L}BOD * 90{,}000{,}000\frac{L}{d} * \frac{1\ kg}{1{,}000{,}000\ mg} = 4{,}500\frac{kg}{d} \qquad (Eq.5)$$

Appendix C – Heavy Metal Surface Water Quality Standards Comparison

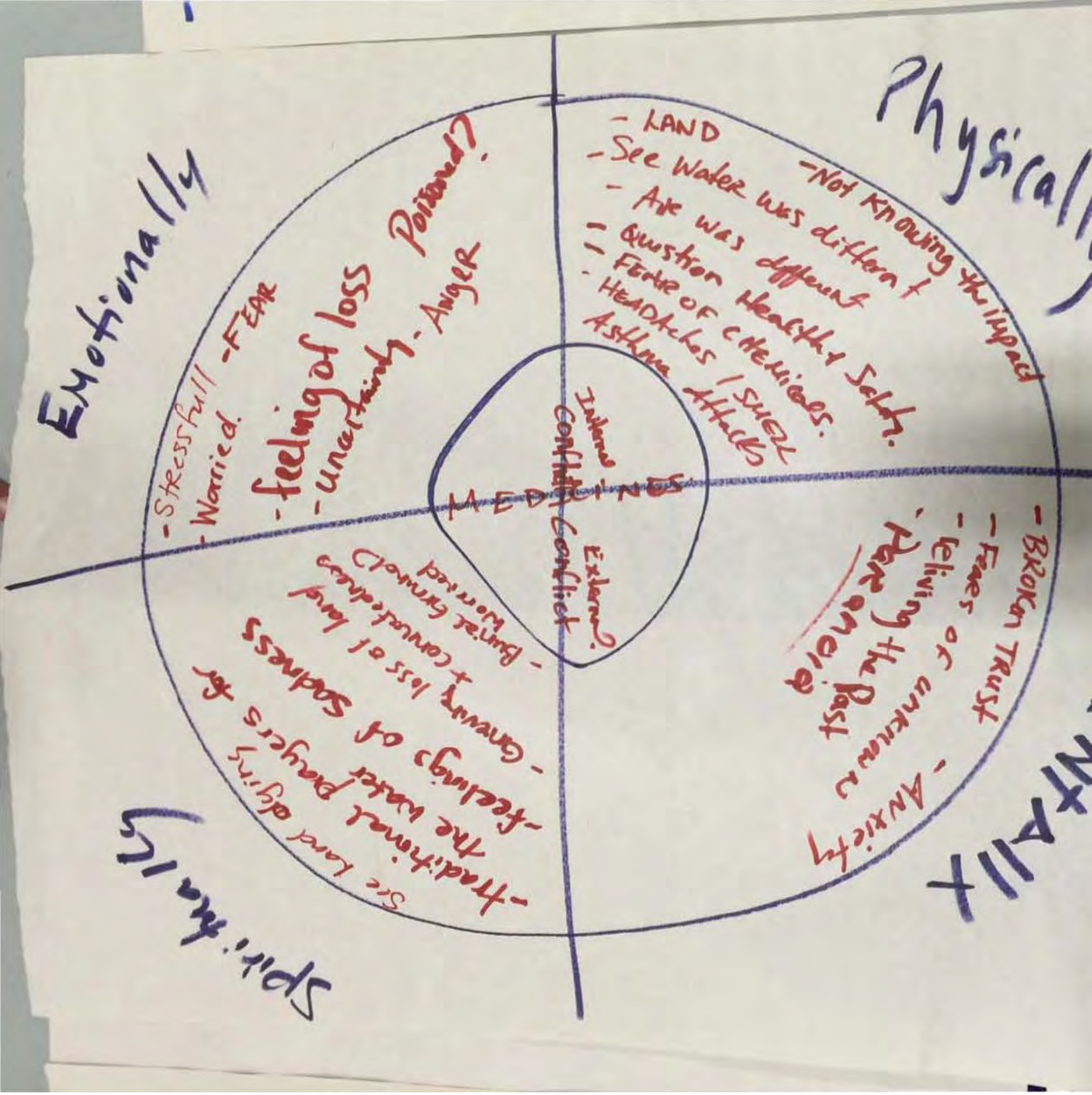
Maximum acceptable concentrations (MAC's) for *Tier 1 Environmental Quality Standards for Surface Waters* that have been exceeded are highlighted in blue. Samples that have exceeded an MAC are highlighted in red.

Table C.1 Tier 1 Environmental Quality Standards for Surface Waters Comparison to Heavy Metals Analysis

*ND – No Data
-------- No MAC

Metals (ug\L)	Surface Water Standards		Site #1 – Pipe Break Source	Site #2 - Wetland	Site # 4 - East River
	Fresh Water	Marine Water			
Total Aluminum (Al)	5	--------	12000	2200	820
Total Antimony (Sb)	20	500	*ND	*ND	*ND
Total Arsenic (As)	**5**	**12.5**	**9.9**	**6**	**7.8**
Total Barium (Ba)	1000	500	220	150	310
Total Beryllium (Be)	5.3	100	*ND	*ND	*ND
Total Bismuth (Bi)			*ND	*ND	*ND
Total Boron (B)	1200	1200	69	72	830
Total Cadmium (Cd)	**0.01**	**0.12**	**0.89**	**1.1**	**0.53**
Total Calcium (Ca)			17000	21000	99000
Total Chromium (Cr)	--------	--------	11	3.5	2.1
Total Cobalt (Co)	10	--------	8.1	1.6	2.2
Total Copper (Cu)	**2**	**2**	**37**	**11**	**13**
Total Iron (Fe)	**300**	--------	**9800**	**2100**	**2300**
Total Lead (Pb)	**1**	**2**	**18**	**8.7**	**11**
Total Magnesium (Mg)			2400	2400	200000
Total Manganese (Mn)	**820**	--------	**1100**	790	**3100**
Total Molybdenum (Mo)	**73**	--------	**82**	**100**	37
Total Nickel (Ni)	25	**8.36**	**17**	6.9	5.3
Total Phosphorus (P)			750	1000	410
Total Potassium (K)			8400	12000	66000
Total Selenium (Se)	**1**	**2**	**2.8**	**6.8**	**2.4**
Total Silver (Ag)	**0.1**	1.5	**0.19**	**0.18**	*ND
Total Sodium (Na)			210000	320000	1800000

Metals (ug\L)	Surface Water Standards		Site #1 – Pipe Break Source	Site #2 - Wetland	Site # 4 - East River
	Fresh Water	Marine Water			
Total Strontium (Sr)	2100	--------	37	63	1300
Total Thallium (Tl)	0.8	21.3	0.24	0.5	0.11
Total Tin (Sn)	--------	--------	*ND	*ND	*ND
Total Titanium (Ti)			110	25	15
Total Uranium (U)	300	100	2	1.2	1.9
Total Vanadium (V)	**6**	50	**16**	**7.5**	**7.5**
Total Zinc (Zn)	**30**	**10**	**72**	**78**	**26**


Physically
Emotionally
Spiritually
MEDICINES
Internal Conflict
External Conflict
- LAND
- See Water was different
- Not knowing the impact
- Air was different
- Question Healthy Safety.
- FEAR OF CHEMICALS.
- HEADAches / SMELL
Asthma Attacks
- Stressfull - FEAR
- Worried.
- feeling of loss
- uncertainty - Anger
Poisoned?
- BROKEN TRUST
- Fears of unknown
- Reliving the past
- Paranoia
- ANXIETY
- Burial Grounds Worried
- Grieving loss of land + connectedness
- feelings of sadness for
- traditional the water prayers
See land dying