DEPARTMENT OF
ECOLOGY
State of Washington

Economic Impact Analysis

AKART Analysis

DRAFT National Pollutant Discharge Elimination System (NPDES) Wastewater Discharge General Permit for Boatyards

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Economic Impact Analysis

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DRAFT National Pollutant Discharge Elimination System (NPDES) Wastewater Discharge General Permit for Boatyards

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Note to Reader: This report originally analyzed a draft permit modification of the 2005 boatyard general permit. Ecology subsequentially decided to reissue the permit based on comments received on the draft modification and on a draft of this report.

Executive Summary

The Boatyard General Permit is a statewide permit that provides coverage for discharges of stormwater from boatyards. The permit specifically regulates discharges of stormwater to surface water bodies.

The Department of Ecology's (Ecology) Waste Discharge General Permit Program rule (WAC 173-226-120) requires an economic analysis of any draft wastewater general permit intended to directly cover small businesses. The analysis is required to serve the following purposes:

- A brief description of the compliance requirements of the draft general permit.
- The estimated costs for complying with the permit, based on existing data for facilities to be covered under the general permit.
- A comparison, to the greatest extent possible, of the cost of compliance for small businesses with the cost of compliance for the largest ten percent of the facilities to be covered under the general permit.
- Discuss what mitigation the permit provides to reduce the effect on small businesses (if a disproportionate impact is expected), without compromising the mandated intent of the permit.

RCW 19.85.020(4) defines a small business as any business entity, including a sole proprietorship, corporation, partnership, or other legal entity, that is owned and operated independently from all other businesses, and that has fifty or fewer employees.

Ecology also included an AKART analysis in this report using economic data from boatyards and shipyards. We also examined several stormwater treatment options for performance and economic achievability.

Changes to the permit

The draft permit:

- Lowers the benchmarks for copper and zinc stormwater discharges to surface waters.
- Increases the amount of monitoring for discharges to waters of the state from 5 times a year to monthly.
- Includes more stringent sampling requirements.

Costs to comply with the draft permit

Ecology determined annualized compliance costs at **$29,000 - $68,000 for small boatyards** and **$51,000 - $139,000 for large boatyards.**

Ecology used cost-to-sales ratio as the measure of proportionate impact. To calculate the ratio, Ecology divided annualized compliance costs by median annual sales. The cost-to-sales ratio falls as sales rise, so large businesses—which employ more people and have disproportionately higher sales—incur a lower cost per $100 of sales. Ecology concluded, based on this result, that **the draft general permit has a disproportionate impact on small businesses.**

Ecology determined that because the sales for large boatyards are 16 times the sales for small boatyards, even with higher costs for larger boatyards, compliance costs would never be 16 times as high. Therefore, small businesses will always be disproportionately impacted, relative to large businesses.

Mitigation for small business

Ecology has determined there is no opportunity for any significant small business mitigation.

AKART analysis

The AKART analysis shows that treating wastewater from boatyards will be more economically achievable if boatyards are able to increase their prices and use that increase entirely as profit. In that case, boatyards could use all of their sales increase towards installing a wastewater treatment device. Boatyard owners who commented on a draft of this report said they do not believe they will be able to raise prices in the current economy. However, we did not want to ignore the possibility of passing costs onto consumers.

Section One: Economic Impact Analysis

Chapter 1: Permit history

When boatyards build, repair, and paint boats they create pollutants that are carried by stormwater into surface waters. This wastewater contains copper, zinc, and lead that are very harmful to the environment. The Boatyard General Permit regulates stormwater discharges from boatyards to surface water bodies.

Task P-20 of the Puget Sound Water Quality Authority Plan, directed Ecology to carry out a program to detect and identify unpermitted discharge sources. Under this program, the Elliott Bay and Lake Union Urban Bay Action Teams found a significant unpermitted point source discharge - the boatyard industry.

Memorandum of Agreement with the Environmental Protection Agency (EPA)

In 1990, Ecology signed a Memorandum of Agreement with the Environmental Protection Agency (EPA) agreeing to develop and issue a general permit for small shipyards. During the development of the permit, Ecology decided to describe facilities in this segment of the Ship and Boat Building and Repairing industry as boatyards. Shipyards receive individual permits. A general permit for boatyards was issued in 1992, reissued in 1997 and again in December 2005 (current permit). The 2005 permit was modified in 2006 to correct an error.

Appeal of 2005 and 2006 permit modification

The Northwest Marine Trade Association (NMTA) and the Puget Soundkeeper Alliance (PSA) appealed the 2005 and 2006 permit modification. The Pollution Control Hearings Board (PCHB) heard the appeal in July 2006 and they issued a decision in January 2007. The NMTA and PSA then appealed the PCHB decision to Superior Court.

The appeal to superior court was conditionally settled by incorporating some of the PCHB judgment orders into another modified permit in January 2008. The settlement agreement included a pilot test of three stormwater treatment technologies during the winter of 2007- 2008. The permit remains under appeal.

Draft permit submitted by NMTA and PSA

In 2008, environmental consultants ARCADIS performed a general economic analysis to estimate the cost of installing the treatment devices. In August 2008, the NMTA and PSA sent a draft permit to Ecology that they said was mutually acceptable. That draft permit is the subject of this analysis. The draft permit was released for public comment in November 2008.The draft contains benchmarks for copper and zinc that are based on the pilot study performance of multimedia filtration in the treatment of boatyard stormwater. Ecology believes the benchmarks in the draft permit are only achievable with stormwater treatment.

Definition of boatyard

A boatyard, as defined for the purposes of this permit, is a commercial business engaged in the construction, repair, and maintenance of small vessels, 85 percent of which are 65 feet or less in length, or revenues from which constitute more than 85 percent of gross receipts. This definition includes mobile boatyards.

Services typically provided in a boatyard include, but are not limited to:

- Pressure washing hulls
- Painting and coating
- Engine and propulsion systems repair and replacement
- Hull repair
- Joinery
- Bilge cleaning
- Fuel and lubrication systems repair and replacement
- Welding and grinding of hulls
- Buffing and waxing
- Marine sanitation device (MSD) repair and replacement
- Other activities necessary to maintain a vessel

There are currently 88 total permitted boatyard facilities in Washington State.

Chapter 2: Compliance requirements for the boatyard general permit

Discharge limitations in the draft permit

Discharging pressure wash wastewater to a non-delegated publicly owned treatment works

Boatyards may discharge treated pressure wash wastewater to a municipal sanitary sewer, in accordance with effluent limitations and a monitoring schedule and upon acceptance of the municipality. The boatyard cannot introduce into the publicly owned treatment works (POTW) any pollutant(s), which cause Pass Through, Upset or Interference[1]. In addition, there is a list of 11 other restrictions in the permit that cannot be introduced into the POTW. Boatyards cannot dilute the wastewater discharge with stormwater or attempt to dilute an effluent as a substitute for adequate treatment.

Discharging stormwater to a POTW

[1] **Pass Through**- A discharge to a POTW which exits the POTW into waters in quantities or concentrations in violations of the POTW's permit.

Upset- An incident where there is an unintentional and temporary noncompliance with technology based effluent limitations because of factors beyond the reasonable control of the boatyard.

Interference- A discharge which inhibits or disrupts the POTW and is therefore a cause of a violation of any requirement of the POTW's permit or of the prevention of sewage sludge use or disposal.

Boatyards may discharge stormwater to a POTW only with special approval from Ecology. They must also demonstrate:

- There is no other feasible option.
- The POTW has excess wet season hydraulic capacity.
- The POTW is willing to accept the discharge.
- How the hydraulic loading to the POTW will be reduced by eliminating clean water.
- All applicable Best Management Practices (BMPs) are practiced routinely.

Discharge limits and monitoring requirements are the same for stormwater as for pressure wash wastewater, unless the POTW has more stringent monitoring requirements.

Discharging treated pressure wash wastewater or stormwater to a delegated POTW

Boatyards may discharge pressure wash wastewater or stormwater to a sanitary sewer system operated by a municipality with a delegated pretreatment program provided they receive discharge authorization from the municipality. The municipality will determine limitations, monitoring and reporting requirements, which are expected to be at least as stringent as the requirements of the draft permit. Boatyards must also comply with any applicable sewer use ordinances adopted by the municipality.

Discharging stormwater to waters of the state

All boatyards must manage stormwater discharges to prevent:

- The discharge of synthetic, natural, or processed oil.
- The discharge of floating materials.
- A visible change in turbidity or color in the receiving water.

Boatyards have specific limitations and/or benchmarks listed in the draft permit depending on location or status. They are:

- All boatyards discharging stormwater to Lake Union and the Ship Canal.
- Boatyards discharging stormwater to other fresh and marine waters.
- Boatyards discharging stormwater to an infiltration basin lined with absorptive media.
- Existing dischargers discharging stormwater to impaired waters prior to a total maximum daily load (TMDL) study and allocation.
- New boatyards discharging stormwater to impaired waters prior to a TMDL study and allocation.

These limitations for surface discharges are more stringent than the current permit. The specific limitations are discussed below in the monitoring section.

Boatyards must comply with:

- Washington State surface water quality standards (Chapter 173-201A WAC)
- Sediment management standards (Chapter 173-204 WAC)
- Ground water quality standards (Chapter 173-200 WAC)
- Human health-based water quality criteria in the National Toxics Rule (40 CFR 131.36)

Mandatory best management practices (BMPs)

Boatyards must prepare a handout describing the following BMPs and provide copies to boatyard customers. These BMPs must be posted and incorporated into the boatyard's stormwater pollution prevention plan (SWPPP). The BMPs include:

- Use of vacuum sander and grinders
- Tidal grid restriction
- In-water vessel maintenance repair
- Upland vessel maintenance and repair
- Solids Management
- Paint and solvent use
- Oils and bilge water management
- Sacrificial anode (zincs) management
- Chemical management
- Wash pad decontamination
- Sewage and gray water discharges

Monitoring and sampling requirements

These monitoring requirements outlined in the table below are more frequent than the current permit. Samples must be collected from location(s) affected by boatyard related activities.

Table 1: Monitoring and Sampling Requirements

Category	Parameter	Minimum Sampling Frequency
Pressure washer wastewater to sanitary sewer	Total copper, zinc, lead, and pH	One time in each of the months of June, July, August, and September
Stormwater discharges to waters of the state	Total copper, zinc, and lead	Once a month
	Visual monitoring	Once a week
Stormwater to marine waters	Biochemical oxygen demand (BOD), nitrate and nitrite nitrogen (NO3+NO2-N), and fecal coliform	One time in the winter, during the permit term
Stormwater to fresh water	BOD, total phosphorus, fecal coliform	One time in the winter, during the permit term
Non stormwater miscellaneous discharges	Total copper and zinc	Once a month

Boatyards must sample stormwater according to the permit instructions unless the boatyard is approved by Ecology for an alternative plan. The boatyard must follow the sampling requirements below but is not required to sample outside regular business hours or when it is unsafe. These sampling requirements are more stringent than the current permit.

- The boatyard may take a grab sample, a time-proportionate sample, or a flow proportionate sample.
- All samples are to be taken as reasonably practical and which can be achieved safely.

- The storm event sampled is at least 0.1 inches of rain in a 24-hour period or has an intensity equal to 0.1 inches or greater in a 24-hour period preceding sample collection.
- The storm event sampled is preceded by at least 24 hours of no greater than trace precipitation.
- Sampling is conducted to capture stormwater with the greatest exposure to significant sources of pollution. If offsite discharging points are likely to result in different concentration or types of pollutants, each point must be separately sampled and analyzed. If discharge points do not vary, sampling may occur only at the discharge point with the highest concentration.
- Besides visual monitoring, a boatyard is only required to sample once per month and use its best efforts to achieve the storm event sampling criteria.

Required analytical procedures

Sampling and analytical methods used to meet the water and wastewater monitoring requirements specified in the permit must conform to the latest version of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136.

Laboratory accreditation

All monitoring data required by Ecology in the permit or by order must be prepared by a laboratory registered or accredited under the provisions of, *Accreditation of Environmental Laboratories*, Chapter 173-50 WAC.

Stormwater Pollution Prevention Plan (SWPPP)

Every boatyard required to meet the benchmarks in the general permit for boatyards must prepare and maintain a Stormwater Pollution Prevention Plan (SWPPP) specifically designed for their boatyard. The SWPPP must be:

- Consistent with permit requirements.
- Fully implemented.
- Updated as necessary to maintain compliance with permit conditions.

The SWPPP must include BMPs necessary to meet the indicated benchmarks. New boatyards must have a SWPPP developed and implemented before they can operate.

The SWPPP must document the:

- Technical basis for how stormwater BMPs were selected.
- Pollutant removal performance expected from the BMP selected.
- Technical basis that support the performance claims for the BMPs selected.

The SWPPP must also provide an assessment of how each of the selected BMPs will:

- Comply with state water quality standards and
- Satisfy the state AKART requirements and the federal technology-based treatment required under 40 CFR Part 125.3.

At minimum, the SWPPP must include:

- Facility assessment
- Monitoring plan
- BMPs

Operational Source Control BMPs are common to all boatyards and the categories listed below are a minimum set of BMPs that must be included in the SWPPP:

- Pollution prevention team
- Good housekeeping
- Preventive maintenance
- Spill prevention and emergency cleanup plan
- Employee training
- Inspections and recordkeeping

Reporting and recordkeeping

The draft general permit sets requirements for reporting and recordkeeping.

Reporting

Boatyards must submit monitoring results in accordance with the minimum sampling frequencies specified in the permit. All data collected must be submitted to Ecology. Data collected during the previous month or sample period must be summarized and reported on a form provided.

Records retention

Boatyards must retain records of all monitoring information for a minimum of five years. Such records shall include:

1. All calibration and maintenance records.
2. All original recordings for continuous monitoring instruments.
3. Copies of all reports required by the general permit.
4. Records of all data used to complete the application to be covered under the general permit.

Recording of results

For each measurement or sample taken, the boatyard must record all of the following:

1. Date, exact place, method and time of sampling
2. The individual who performed the sampling or measurement
3. Dates the analysis were performed
4. Name of the person(s) who performed the analyses
5. The analytical techniques or methods used
6. The results of the analysis

Results from additional monitoring

If the boatyard monitors any pollutant identified in the general permit with more frequency than required using test procedures specified by the receiving waters studies, then the results must be included in the calculation and data submitted in the discharge monitoring report.

Discharges to a delegated municipal; sanitary sewer system

Boatyards who discharge treated pressure wash wastewater to a delegated municipal sanitary sewer system must maintain records of their contractual agreement with the municipality, including conditions of discharge. These records must be available for inspection.

Bypass

Bypass is the intentional diversion of waste streams from any portion of a treatment facility. It is illegal to use this practice for stormwater events unless it meets the approved design criteria for stormwater management. Ecology may take enforcement action unless one of the following circumstances applies:

1. Bypass is consistent with the design criteria and part of an approved management practice.
2. Bypass is essential for management maintenance and it does not have the potential to violate permit limits or conditions.
3. Bypass is unavoidable, unanticipated, and results in noncompliance with this permit. If a planned action that would cause bypass of stormwater and has the potential to result in noncompliance with this permit during a stormwater event, the boatyard must notify Ecology at least thirty days before the planned action and possible date of bypass.

Solid waste management

The boatyard must manage all solid waste materials to prevent release of leachate into waters of the state. Leachate is defined as water or other liquid that has been contaminated by dissolved or suspended materials due to contact with solid waste or gases.

Reporting for zebra mussel control

A boat/vessel identified as a carrier of zebra mussels must be quarantined and the appropriate Washington Fish and Wildlife Regional Office notified within 24 hours. The boat/vessel must not be released, re-launched, pressure washed, or have its bilge pumped until it has been cleared by the U.S. Fish and Wildlife Services of the Washington State Department of Fish and Wildlife.

Chapter 3: Overview of analysis

This Economic Impact Analysis (EIA) estimates the costs of complying with the draft general permit for boatyards. It also compares the costs of complying with the draft general permit for small businesses, to the costs of compliance for large businesses, to determine whether the requirements of the draft general permit disproportionately impacts small businesses.

The scope of the analysis deals only with the direct compliance costs imposed by the draft general permit to the boatyard industry. Ecology is not required in an Economic Impact Analysis to evaluate benefits and therefore will not do so here.

Small and large businesses

RCW 19.85.020(4) defines a small business as any business entity, including a sole proprietorship, corporation, partnership, or other legal entity, that is owned and operated

independently from all other businesses, and that has fifty or fewer employees. There are both small and large businesses in the boatyard industry. Overall boatyards average 29 employees, while 85 percent of boatyards in Washington are considered small. Among the small boatyards, the average is 15 employees, and the large boatyards average 177 employees.

The following table shows data on the number of facilities under the current general permit with 50 or fewer employees, and with more than 50 employees. This table also displays small and large business information by firm, because there are some firms within the boatyard industry that operate multiple facilities.

Table 2: Small and Large Facilities and Businesses

Employees	Number of Facilities	Number of Firms
50 or Fewer	71	71
More Than 50	17	12
Sources:		
Washington State Employment Security Department, Workforce Explorer. www.workforceexplorer.com/aspdotnet/databrowsing/empMain.aspx?menuChoice=emp		
Hoovers Online. http://premium.hoovers.com		

Boatyards range in sizes from 0.2 acres to 5 acres. Ecology does not know the acreage of the individual boatyards, but according to the Arcadis survey of boatyards, a typical boatyard is 2 acres. Because 85 percent of boatyards are considered small, we therefore believe it is reasonable in general to assume small boatyards to be 2 acres and large boatyards to be double the acreage of small boatyards, 4 acres.

In addition, businesses that own and operate boatyards come from a variety of North American Industry Classification System (NAICS) codes.[2] The impacted NAICS codes are listed below.

Table 3: Impacted Industries NAICS Codes

336611	Shipbuilding and Repair
423860	Transportation equipment and supplies (except motor vehicle) merchant wholesalers
441222	Boat Deals
488320	Marine Cargo and Handling
488390	Other Support Activities for Water Transportation
713990	All Other Amusement and Recreation Industries
811310	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance
811490	Other personal and household goods repair and maintenance
Source:Washington State Employment Security Department, Workforce Explorer. http://www.workforceexplorer.com/aspdotnet/databrowsing/empMain.aspx?menuChoice=emp Hoovers Online. http://premium.hoovers.com	

[2] NAICS codes are currently the standard used to define industries, and are used here in place of Standard Industry Classification (SIC) codes.

Ecology must compare the cost of compliance for small business with the cost of compliance for the 10 percent of boatyards that are the largest businesses required to comply. Ecology was able to obtain data on 76 percent of the boatyards. Ecology has employment and sales data on 65 small boatyards and 7 large boatyards. These 7 large boatyards are ten percent of the 72 boatyards we have data on.

Compliance costs included in the EIA

According to WAC 173-226-120, the EIA must estimate the costs of the following:

- Minimum treatment technology
- Monitoring
- Reporting
- Recordkeeping
- Plan submittal
- Equipment
- Supplies
- Labor
- Administrative costs

Compliance costs excluded from the EIA

The cost of complying with the following laws and rules as they relate to complying with general permit conditions are not included in the EIA's analysis of compliance costs:

1. State Groundwater Quality Standards (WAC 173-200)
2. State Surface Water Quality Standards (WAC 173-201)
3. State Sediment Management Standards (WAC 173-204)
4. Wastewater Discharge Permit Fees (WAC 173-224)
5. Federal law and regulations, in particular the Clean Water Act and federal NPDES regulations.

The justification for excluding compliance costs related to these laws and rules is that permit holders cannot be exempt from these laws through the permit process and, therefore, any cost impacts of these laws and regulations cannot be mitigated. Permit holders must comply with existing regulation independent of permit requirements.

Existing boatyards under the 2005 general permit are already expected to comply with much of the draft general permit's requirements. They have already incurred some of the costs of complying with the draft general permit. However, even though a certain compliance cost has been incurred in the past, it is still a cost of compliance.

State and federal water pollution regulations

The federal Clean Water Act (CWA) requires those that discharge to surface waters obtain a National Pollutant Discharge Elimination System (NPDES) permit. NPDES regulations establish technology-based effluent standards. At a minimum, Ecology's boatyard general permit must

impose a level of pollution control that is at least as strict as that set by federal laws and regulations.

Ecology must also ensure that AKART levels of pollution control are established in the general permit. AKART is a state technology-based requirement (see RCW 90.48.010). AKART may be stricter than federal effluent standards; however, it cannot be less strict.

In addition, all permits issued by Ecology must ensure dischargers do not violate the state:

- Water quality standards for surface waters of the state (WAC 173-201A)
- Water quality standards for ground waters of the state(WAC 173-200)
- Sediment management standards (WAC 173-204)
- Wastewater discharge fees (WAC 173-224)

Chapter 4: Estimated costs for complying with the permit

The costs for boatyards to comply with the draft general permit depend on the size of the boatyard. In this chapter, Ecology estimated ranges of costs for most requirements - a low cost and a high cost. The low cost estimate is for small boatyards and the high cost estimate is for large boatyards. Some requirements have the same cost for small and large boatyards, while other costs are presented as a range.

Most of the major assumptions used to estimate compliance costs are in this chapter. In particular, assumptions used to estimate capital costs are included. Capital costs and its associated operation and maintenance (O&M) costs are annualized to compare them to the services boatyards provide annually.

It is necessary to annualize costs because some costs are annual (incurred every year), while other costs are capital costs (incurred once). For example, installing a stormwater treatment technology is a one-time capital cost, while recordkeeping are annual costs that must be incurred every year. In addition, some of the treatment options have different project life expectations and therefore it is necessary to annualize costs to compare them.

Meeting discharge benchmarks/limits

The draft general permit proposes to change the benchmark/limits for copper and zinc for stormwater discharges to surface waters. See Table 4 for the proposed limits.

Table 4: Proposed Limits for Copper and Zinc in Draft General Permit

Type of pollutant	Maximum Daily Benchmark	Seasonal Average Benchmark
Copper	29	14.7
Zink	146	95

Ecology believes that no boatyard can currently reach these proposed benchmarks limits with their current source control BMPs. To meet the new benchmarks, each boatyard will need to

install a stormwater treatment technology. The Boatyard Stormwater Treatment Technology Study (Taylor Associates 2008) presents the results of a pilot study of three treatment devices for treatment of boatyard stormwater. The costs of these treatment technologies for a typical two-acre boatyard are estimated by ARCADIS consultants (2008).

Some of the cost data for treatment options, which are presented below, are considered to be "order of magnitude" as defined by the American Association of Cost Engineers. The accuracy of this estimate is assumed to be +50percent to -30percent.

In addition to this analysis by ARCADIS, Ecology has reviewed cost data from Pacific Fisherman Shipyard & Electric, LLC who had an engineering report done for their shipyard in December 2008. Ecology also has cost data from StormwateRx®, which is the stormwater treatment technology that was the least expensive for level of performance in the pilot study. For this reason, Ecology assumes most boatyards will choose this device or equivalent technology. StormwateRx® has installed its treatment device at 7 boatyards in the Puget Sound area in recent years.

Based on a survey of 12 boatyards, the ARCADIS analysis estimated that an average 2 acre boatyard would require site improvements on about half of the site to effectively collect and treat stormwater. Ecology has incorporated this estimate into boatyard costs.

The estimates of costs include yearly operation and maintenance (O&M) costs and the project life is assumed to extend for 15 years.

Table 5 shows the capital costs, annual O&M and annualized cost from each data source for boatyards that do not need site improvements. Actual cost data from the 7 boatyards where the treatment has been installed was weighted by a factor of 2 in calculating averages.

Table 6 shows the cost estimate from ARCADIS when typical site improvements are necessary. Based on the ARCADIS data, the capital costs of the technology will require boatyards to borrow money to install it. We use a 5.48 percent real interest rate (accounting for expected inflation), and varying assumptions about the useful life span for capital goods[3].

Table 5: Stormwater Treatment Costs without Site Improvements

Data Source	Capital Costs		Annual O&M Costs		Annualized Costs	
	Small	Large	Small	Large	Small	Large
StormwateRx® Avg.*	$91,400	$182,800	$3,500	$7,000	$15,900	$31,700
Pacific Fisherman	$404,800	$809,600	$26,200	$52,400	$65,000	$130,000
Arcadis	$92,000	$184,000	$14,000	$28,000	$22,600	$45,200
Weighted Mean					**$19,400**	**$38,800**

* Assumed minimal site preparation reqired

[3] To calculate the real discount (interest) rate, Ecology used the current average rate for small business loans (8.1% from BusinessWeek Small Business Rate Report http://www.businessweek.com/smallbiz/resources/rate_report/borrowers.htm), and subtracted expected inflation as based on semi-annual rates reported by the US Treasury between September 1998 and November 2008.

Table 6: Stormwater Treatment Costs when Typical Site Improvements are Needed

Data Source	Capital Costs		Annual O&M Costs		Annualized Costs	
	Small	Large	Small	Large	Small	Large
Arcadis	$353,000	$706,000	$17,000	$34,000	**$52,000**	**$104,000**

Ecology estimates the range of annualized costs for installing stormwater treatment technology at $19,400 to $52,000 for small boatyards and $38,800 to $104,000 for large boatyards. For a comparison of the costs of other treatment options, see Section Two, Chapter 1 of this paper.

Monitoring and analysis costs

Monitoring requirements are specific to the type of wastewater treatment and disposal methods used by the permit holder. Samples must be monitored and analyzed according to the general permit. There is no difference in the monitoring costs for small and large boatyards. The draft general permit requires boatyards to monitor:

- Wastewater discharges to a POTW from pressure washing
- Stormwater discharges to waters of the state

Wastewater discharged to sanitary sewers from pressure washing

Monitoring pressure washer wastewater discharged to a POTW is a federal pretreatment requirement and therefore is exempt from analysis in this permit.

Stormwater discharged to waters of the state

Stormwater discharged to waters of the state must be monitored at all boatyards. Samples must be collected from a location or locations affected by boatyard related activities. Based on comments received of the skill level of employees and public yards having to pay the prevailing wage, Ecology assumes a wage rate of $34.23 per hour[4]. The costs for monitoring and analyzing stormwater are the same for small and large businesses and are shown in the following table:

Table 7: Total Costs for Stormwater Monitoring

Category	Parameter	Hours	Minimum Monitoring	Cost of Analysis	Annual Cost
Stormwater	Copper, Zinc, Lead, Total	5	1/month	$76 for 3 metals	$1,3,000
Stormwater	Visual Monitoring	0.5	1/week	$0	$890
Stormwater to marine waters	BOD, NO3+NO2-N, Fecal Coliform	No additional sampling	One time in the winter	BOD= $55 NO3+NO2= $13 Fecal Coliform= $23	$91
Stormwater to fresh waters	BOD, Total Phosphorus, Fecal Coliform	No additional sampling	One time in winter	BOD= $55 Total Phosphorus = $18 Fecal Coliform = $13	$86
Non Stormwater Misc Discharges	Copper, Total Zinc, Total	Nobody is reporting they have these	1/month		$0
Total Costs					**$4,067**

[4] Washington State Department of Labor & Industries- Prevailing Wage Rates for Public Works Contracts for Shipbuilding & Ship Repair in King County http://www.lni.wa.gov/PrevailingWage/jwages/20092/Ship.asp

Stormwater Pollution Prevention Plan

Every boatyard required to meet the benchmarks/limits in the draft general permit must prepare a Stormwater Pollution Prevention Plan (SWPPP) specifically designed for their boatyard. Each SWPPP must include the BMPs necessary to meet the benchmarks/limits in the draft general permit. The SWPPP is a requirement of EPA's Multisector Stormwater General Permit and therefore exempt from this analysis as a federal requirement. Additionally, the BMPs listed in the EPA's Multisector Stormwater General Permit are exempt from analysis. However, the additional BMPs that are mandatory for all boatyards in Washington but are not required by EPA must be included in this analysis.

Exempt BMPs

1. Pollution prevention team
2. Good housekeeping
3. Preventive maintenance
4. Spill prevention and emergency cleanup
5. Employee training
6. Inspections and recordkeeping

BMPs Included in Analysis

1. **Use of a vacuum sander**- A vacuum sander or rotary tool meeting minimum performance standards shall be used for all paint removal where a sander is appropriate. Ecology has reported that boatyards may recover the costs of this equipment by renting the units to people refinishing their own boats.

2. **Tidal grids**- Tidal grids are only used for emergency repair and marine surveying. Tidal grids cannot be used for surface preparation, painting, routine maintenance, or other non-emergency uses. This requirement has zero cost.

3. **In-water vessel maintenance repair**- Cleaning, repair, modifications, surface preparations, or coating of a vessel's hull is prohibited while the vessel is afloat. Repairs, modifications, surface preparation, or coating of topside or superstructure is limited to 25 percent of the topside or superstructure surface. Equipment required: drop cloths, tarpaulins, drapes, shrouding or other protective devices.

4. **Upland vessel maintenance repair**- Material from maintenance and repair need to be collected and managed to prevent their release into the environment and entry into waters of the state. Equipment required: drop cloths, tarpaulins, structures, drapes, shrouding or other protective devices.

5. **Solids management**- Cleanup of debris and paint should be collected a minimum of once a day when solid-generating activity is occurring. Sediments traps are required to be installed in all storm drains to intercept and retain solids before being discharged.

6. **Paint and solvent use**- Paints and solvents should be used in a manner that prevents their release into the environment and entry into waters of the state. Equipment required: drip pans, drop cloths, tarpaulins or other protective devices.

7. **Oils and bilge water management**- Hydraulic fluids, oily wastes and petroleum products cannot be discharged to waters of the state. Bilge water discharges must not cause any visible sheen in waters of the state. Large boatyards typically use an oil water separator[5], while small boatyards will let bilge water set for separation in a large drum.

8. **Sacrificial anode (zincs) management**- Zincs must not be disposed into the water and spent zinc must be stored in a covered container.

9. **Chemical management**- All chemicals must be stored under cover on an impervious surface.

10. **Wash pad decontamination**- Before discharging any stormwater from pressure wash pads, the pad must be cleaned. The pad must then be pressure washed into the collection sump and the sump cleaned of all debris. Depending on how busy the boatyard is and the time of year, this may occur as much as daily or as little as twice a year. This requirement is all labor costs. Ecology assumes a wage rate of $34.23 and that it takes 30 minutes. We assume large boatyards do this twice as often.
    - Small boatyards range: twice a year to every other day (183/year)
    - Large boatyards range: four times a year to once a day (365/year)

11. **Sewage and gray water discharges**- Sewage and gray water may not be discharged from boats to surface waters. This is a requirement of existing state and federal law and therefore, the compliance cost is zero.

[5] Ecology estimates oil water separators cost $5,000 and last about 15 years. The annualized cost using a 3.19% interest rate is about $400 a year.

The cost estimates for some of these BMPs are taken from the analysis from the original permit and brought up to date by applying a 43.77 percent inflationary factor for 1992-2008.[6] The following table shows the total costs for BMPs.

Table 8: Total Costs for Best Management Practices (BMPs)

BMP	Small Boatyards		Large Boatyards	
	Low	High	Low	High
1. Vacuum sander[7]	$2,700-	$2,700	$2,700-	$2,700
2. Tidal grids	$0-	$0	$0-	$0
3. In-water vessel maintenance repair	$60-	$290	$145-	$1,150
4. Upland vessel maintenance repair	$60-	$290	$145-	$1,150
5. Solids management	$2,100-	$4,700	$4,700-	$17,600
6. Paint and solvent use	$60-	$290	$145-	$1,150
7. Oils and bilge water management	$100-	$100	$400-	$400
8. Sacrificial anode (zincs) management	$50-	$50	$100-	$100
9. Chemical management	$145-	$145	$145-	$145
10. Wash pad decontamination	$34-	$3,130	$70-	$6,250
11. Sewage and gray water discharges	$0-	$0	$0-	$0
Total	**$5,309-**	**$11,695**	**$8,550-**	**$30,645**

Reporting and recordkeeping costs

Reporting

Boatyards must submit monitoring results in accordance with the minimum sampling frequencies specified in Sections II and III of the draft *General Permit for Boatyards*. All data must be collected and submitted to Ecology.

Costs for reporting include labor costs to summarize monitoring results and postage. Ecology assumes that all monitoring done at the same frequency can be reported at the same time. Ecology assumes it takes 30 min at $34.23 per hour wage rate to summarize and prepare the results for reporting and $5.00[8] for postage for each mailing. The following table shows the costs for reporting:

[6] U.S. Department of Commerce: Bureau of Economic Analysis. Gross National Product: Implicit Price Deflator. http://research.stlouisfed.org/fred2/data/GNPDEF.txt

[7] See Appendix A for vacuum sander calculations taken from the 1997 Fact Sheet for NPDES General Permit for Boatyards. Costs were brought up to date by applying a 28.56% inflationary factor for 1997-2008.

[8] Postage is estimated using the United State Postal Service Postage Price Calculator. This is the price estimated for a large envelope to be sent across Washington.

Table 9: Total Costs for Monitoring Results Reporting

Total Costs for Monitoring Results Reporting				
Type of Monitoring Reported	**Hours**	**Frequency**	**Postage Cost**	**Annual Cost**
Stormwater	0.5	12/year	$5.00	$210
Additional Stormwater sampling	0.5	once	$5.00	$22
Total				**$232**

Records retention

Boatyards must retain records of all monitoring information for a minimum of five years. The cost of complying with this provision is the cost of storing records. This cost is likely very low or close to zero.

Total compliance costs

This section presents the total costs of compliance for boatyards under the draft *General Permit for Boatyards*.

Table 10: Total Compliance Costs

Requirements	Small	Large
STORMWATER TREATMENT TECHNOLOGY	$19,400 - $52,000	$38,800 - $104,000
MONITORING		
Stormwater- Copper, Zinc Lead	$3,000	$3,000
Stormwater- Visual Monitoring	$890	$890
Stormwater- BOD, NO3+NO2-N(Total Phosphorus), Fecal Coliform	$91 $86	$91 $86
Stormwater- BOD, Total Phosphorus, Fecal Coliform		
BEST MANAGEMENT PRACTICES		
Vacuum sander	$2,700	$2,700
Tidal grids	$0	$0
In-water vessel maintenance repair	$60 - $290	$145 - $1,150
Upland vessel maintenance repair	$60 - $290	$145 - $1,150
Solids management	$2,100 - $4,700	$4,700 - $17,600
Paint and solvent use	$60 - $290	$145 - $1,150
Oils and bilge water management	$100	$400
Sacrificial anode (zincs) management	$50	$100
Chemical management	$145	$145
Wash pad decontamination	$34 - $3,130	$70 - $6,250
Sewage and gray water discharges	$0	$0
REPORTING		
Stormwater	$210	$210
Stormwater to Marine and Fresh Waters	$22	$22
ANNUALIZED TOTALS	**$29,008 - $67,994**	**$51,649 - $138,944**

Conclusion of estimated costs

The EIA compares the costs of compliance for small and large businesses to determine whether the rule disproportionately impacts small businesses. This is the fundamental requirement that the EIA satisfies.

The cost analysis compares proportionate compliance costs for small businesses and large businesses. With few exceptions, absolute compliance costs will be greater for large businesses than for small. Therefore, costs are normalized to make the comparison valid. Any of the following three ratios may be used to compare costs:

1. Cost per employee
2. Cost per hour of labor
3. Cost per one hundred dollars of sales

Ecology used cost-to-sales ratio as the measure of the proportionate impact. It is an approximate estimate of the percentage rise in costs caused by the draft general permit. This is likely to be how the permit holder looks at compliance costs.

To calculate the ratio, Ecology divided annualized compliance cost by mean annual sales. If the compliance cost ratio is higher for small businesses than it is for large businesses, then small businesses are disproportionately impacted by the general permit.

Table 11 shows total annual compliance costs for small and large boatyards:

Table 11: Total Annual Compliance Costs for Small and Large Boatyard Businesses

Small Businesses		Large Businesses	
Low	High	Low	High
$29,008	$67,994	$51,649	$138,944

Table 12 shows the range of cost-to-sales ratios for boatyards:

Table 12: Cost to Sales Ratio for Small and Large Businesses (Annualized Cost per $100 of Sales)

Midrange Sales		Small		Large	
Small	Large	Low	High	Low	High
$1,400,000	$23,400,000	$2.07	$4.86	$0.22	$0.59

The cost-to-sales ratios fall as sales rise. Ecology concluded, based on this result, that **the general boatyard permit has a disproportionate impact on small businesses.**

Ecology determined that because the sales for large boatyards are 16 times the sales for small boatyards, even with higher costs for larger boatyards, compliance costs would never be 16 times as high. Therefore, small businesses will always be disproportionately impacted, relative to large businesses.

Chapter 5: Mitigation of disproportionate impacts

If the compliance cost ratio is higher for small businesses than for large businesses, then small businesses are disproportionately impacted. Ecology concluded in Chapter 4 that this is the case for the draft *General Permit for Boatyards*.

The general permit rule (WAC 173-226-120) requires that disproportionate economic impacts of general permits on small businesses be reduced, when it is both legal and feasible to do so.

Legality and feasibility are determined by the legal context of existing state and federal regulations, such as the State Water Pollution Control Act (Chapter 90.48 RCW) and the federal Clean Water Act. Cost impacts on small businesses are reduced by modifying the conditions of the permit.

Mitigation involves one or more of the following:

- Establishing differing compliance or reporting requirements or timetables for small businesses.
- Clarifying, consolidating, or simplifying the compliance and reporting requirements under the general permit for small businesses.
- Establishing performance rather than design standards.
- Exempting small businesses from parts of the general permit

Mitigation measures must comply with state and federal requirements.

The general permit rule requiring Economic Impact Analysis (WAC 173-226-120) states that mitigation only needs to be undertaken when it is legal and feasible in meeting the stated objectives of the:

- Federal Clean Water Act
- State Water Pollution Act - Chapter 90.48 RCW.

This provision is an important restriction. If a proposed mitigation measure violates federal law or regulations, or if it violates state statute or rules, then it cannot be undertaken.

The conditions of the draft general permit are based on requirements of federal laws and rules. Significant mitigation of these conditions would be a violation of federal NPDES program rules, which establish effluent standards. Because these conditions are a consequence of federal law, they cannot be mitigated, and the compliance costs associated with them cannot be reduced. The draft general permit must contain effluent limits that are at least as strict as federal effluent standards, to mitigate their impact on small businesses.

Conditions required to meet the AKART requirement of the state Water Pollution Control Act (Chapter 90.48 RCW) are also legal requirements that Ecology cannot allow permit holders to violate. Thus, compliance costs based on the AKART requirement also cannot be mitigated.

Ecology also places conditions in general permits to ensure discharges do not violate the state:

- Water quality standards for surface waters of the state (WAC 173-201A)
- Water quality standards for ground waters of the state(WAC 173-200)
- Sediment management standards (WAC 173-204)
- Wastewater discharge fees (WAC 173-224)

These conditions are legal requirements that Ecology cannot allow permit holders to violate. Compliance costs associated with these conditions of the draft general permit cannot be mitigated.

The above circumstances severely limit Ecology's ability to reduce cost impacts on small businesses. Only costs imposed by permit conditions that are stricter than those required by the above rules can be legally mitigated. For the most part, the draft general permit contains conditions needed to comply with these rules, usually only minor mitigation measures can legally be undertaken. The cost reductions that result are usually small.

Impact of mitigation on effectiveness of general permit

In general, the impact of the draft general permit on small boatyards cannot be mitigated significantly. Because most boatyards are small businesses, the economic impact of the draft general permit on small boatyards cannot be reduced without reducing the effectiveness of the permit in controlling water pollution

Mitigation

Ecology has determined there is no opportunity to significantly reduce the costs of this permit to small businesses.

Section Two: AKART Economic Analysis

The general permit rule (WAC 173-226-070) requires general permits to incorporate "all known, available, and reasonable treatment" which is also a requirement of Chapter 90.48 RCW *Water Pollution Control*. The term AKART has been defined by the Attorney Generals office as:

> Such statutory directions to the Department of Ecology, however, clearly do bring into play the expertise of the department as administrator of the state's water pollution control system. Accord, Weyerhaeuser v. Southwest Air Pollution Control Authority, 91 Wn.2d 77, 586 p.2d 1163 (1978). The precise level of treatment required by those general standards involves, primarily, engineering determinations; i.e., as to what treatment methods are "known," what treatment methods are "available," and what treatment methods are "reasonable" with respect to the particular installation in light of the factual circumstances surrounding it.[19] To make those determinations a review must be conducted by the department of existing engineering technologies in order to enable it to decide which methods of treatment--including but not limited to "secondary treatment" as above defined--are suitable with respect to the waste situation involved in the particular case. Cf, , Weyerhaeuser , supra.[20]
>
> [19.] The use of the encompassing word "all" indicates to us that the existing "state of the art" or "best available" treatment technologies are required to be used. Cf., Weyerhaeuser v. Southwest Air Pollution Control Authority, supra.
>
> [20.] These determinations by the Department of Ecology are, of course, to be made in light of the foundation policy that "waters of the state" shall be of high quality and be maintained to the "highest possible standards to insure the purity of all waters of the state" consistent with various environmental and economic objectives. RCW 90.54.020(3)(b) and RCW 90.48.010.
>
> (AGO 1983 No. 23)

This opinion and other legal decisions have further defined AKART as an engineering and economic decision-making process equal to federal Best Conventional Pollution Control Technology (BCT) and Best Available Treatment Technology Economically Achievable (BAT) technology-based requirements (See Appendix B for the text of the BAT Economic Reasonableness Test, or see the Water Quality Program Permit Writer's Manual, Ecology Publication 92-109 for a discussion of AKART).

Ecology must also place conditions in general permits to ensure that dischargers do not violate the state surface water quality, ground water quality, and sediment management standards (WAC 173-226-070)[9]. These conditions are legal requirements that Ecology cannot allow permit holders to violate. Compliance costs associated with these permit conditions cannot be mitigated because these water quality standards do not contain cost mitigation allowances.

[9] WAC 173-226-070, Permit effluent limitations. http://apps.leg.wa.gov/WAC/default.aspx?cite=173-226-070

CHAPTER 1: All Known available and reasonable treatment (AKART) pilot test

The 2005 General Permit for Boatyards defined best management practices (BMPs) as All known available and reasonable treatment (AKART) (technology-based limitations) to meet the state and federal requirements. Benchmarks/limits for the general permit were derived using water quality criteria, translators, a water effect ratio, and a dilution factor. The Pollution Control Hearings Board (PCHB) determined that BMPs were not AKART for boatyards because few boatyards were implementing the required BMPs. Absent the use of AKART and with the high concentrations of copper discharged, the PCHB ruled against the use of a dilution factor in calculating the benchmarks/limits.

The boatyard stormwater pilot test done in the winter of 2007/ 2008 examined the performance of three "state of the art" treatment technologies for stormwater treatment for metals. The multimedia filtration unit (StormwateRx®) demonstrated the best performance at the lowest cost. The draft general permit is the outcome of the court settlement between NMTA and PSA and is the subject of this analysis; it contains benchmarks/limits that were based on the performance of this treatment device during the pilot. The pilot test and the cost of installing treatment were discussed earlier.

The reasonable test for AKART

To define "reasonable" Ecology examined EPA's *Guidance Manual for Estimating the Effects of Pollution Control Costs* (draft). This manual recommended a 3-step process for determining BAT (Best Available Technology Economically Achievable) effluent limits:

- First, perform a firm-level test.
- If the control technology passes the firm-level test, but the permit holder protests that the technology is not economically achievable, then perform a plant-level test.
- If the firm-level test is inconclusive, then a plant closure analysis must be conducted.

These tests of economic achievability are detailed in Ecology's *Permit Writer's Manual Chapter Four*. Please see Appendix B for the text of the BAT Economic Reasonableness Test.

Ecology believes a firm-level test is not meaningful. A large business will expect each of its boatyards to be profitable. Also in most cases, the firm-level test is meaningless and will probably be disputed by the permit holder. In addition, for many businesses, balance sheets, and stock price data, which is required to perform the firm-level test, is not publicly available. Therefore, we have chosen to perform the plant-level test.

There are three plant level-tests. Each test is designed to conclude whether or not a plant's or in this case a boatyard's earnings before taxes would be greater than zero if it installed the proposed technology. According to EPA, only one of the plant-level tests needs to be done because the three tests are essentially the same. The only difference is the amount of data they require. EPA's Guidance Manual defines a treatment technology to be economically achievable if its use would

not cause the plant (boatyard) to shut down. That is, the technology is economically achievable if its annual cost is less than the plant's (boatyard's) annual profits.

The three plant-level tests are:

1. Earnings test
2. Gross margin test
3. Revenue test

These economic achievability tests have been developed for case-by-case limits for individual facilities. The tests are not historically used for general permits where one permit covers a range of economic capability. However, because of the lack of a general permit test, Ecology used the Earnings Test. This analysis examines the boatyard industry in Washington State and a range of options available for pollution prevention and stormwater treatment. Some of the options, as noted below, will be available to only a small number of boatyards. The draft general permit contains a process that reviews each boatyard's ability to install stormwater treatment after the boatyard exceeds the benchmarks/limits a number of times.

As noted in the EIA, some of the cost data for treatment options, which are presented below, are considered to be "order of magnitude" as defined by the American Association of Cost Engineers. The accuracy of this estimate is assumed to be +50percent to -30percent.

Assumptions

It is important to note that all three of the plant-level tests are conservative. They assume the permit holder cannot pass any portion of the cost of the technology on to customers. The cost is assumed to come completely out of profits. The tests assume the cost of the pollution control technology is an additional cost, but that revenue is constant. Generally, this assumption is incorrect for many of the industries that hold permits because the permit holder will be able to pass along a portion or all of the cost, thus lowering the impact of the cost of the technology on its profits. This is especially true if all the boatyards in a region increase costs concurrently.

Therefore, to account for this, Ecology assumes that a boatyard will be able to relatively raise prices without losing business to Canada or Oregon. Ecology does not know the elasticity of the market and therefore we present two scenarios where, for illustrative purposes, Ecology assumes each boatyard will increase sales by 10 percent[10]:

1. Sales increase ten percent and only the industry profit margin can be used for profit
2. Sales increase by ten percent but entire increase can be used as profit.

When the industry profit margin is applied, the results are nearly identical to the results if no sales increase is assumed. Therefore, if a boatyard does not believe it can raise prices, the earnings test will yield almost the same results as increasing sales by 10 percent and using the industry profit margin for profit.

[10] Ecology's Water Quality Staff estimate

In this chapter, Ecology is dealing with a typical boatyard, which we assume to be 2-acres. We believe there are economies of scale for larger boatyards, but do not know to what extent. Most likely, it is less than double the costs.

Data

Ecology was able to get annual sales data for almost all current permit holders through Hoover's database.[11] With two exceptions, all permit holders only operate one boatyard and therefore their data was listed in Hoover's at the plant-level. Two businesses have multiple boatyards. Ecology requested and received their data.

Annual sales were then multiplied by the industry Operating Income margin (5.1 percent)[12] to obtain operating income, or earnings before taxes (EBT).

Treatment technologies

Ecology has examined several options for stormwater treatment technologies. As stated earlier, some of the options will only be available to a small number of boatyards.

Best management practices (BMPs)

BMPs are the minimum control practice that should be in place at every boatyard. These controls have been required for 15 years for boatyards. There are costs associated with mandatory BMPs (current permit conditions S28 a through k), and control of pressure wash water. However, it is assumed that these costs have been incorporated into boatyard charges and are fully recovered. The original equipment costs (vacuum sanders, covers for zincs, pressure wash recycle, etc.) are assumed to have been fully depreciated.

Ecology testified (PCHB 2006) that boatyards were not fully implementing BMPs resulting in high concentrations of copper being discharged. This is an enforcement issue and not a statement of the adequacy of the pollutant control method. However, because BMPs are not being fully implemented, their performance in pollutant reduction cannot be quantified accurately. Ecology notes that the median concentration of copper in boatyard stormwater is now 100 µg/L compared to 400 µg/L in the previous permit cycle. This is assumed to be due to better implementation of BMPs.

Ecology assumes BMPs are economically achievable for all boatyards because all boatyards should be in compliance with them now and are still in business.

[11] www.hoovers.com

[12] First Research- Industry Profile for Shipbuilding and Repair. www.firstresearch.com

Disposal to a publicly owned treatment works (POTW)

Disposal to POTW may be available to a few boatyards. Cities must be agreeable for this disposal and Ecology has imposed restrictions on this option to assure the stormwater doesn't contribute to sanitary sewer overflows or treatment plant bypasses during wet weather.

The cost based on actual cost of shipyard stormwater discharge to Seattle/King Co. municipal treatment system is $8.89 per 100 ft^3 (748 gallons)[13]. A Seattle area 2-acre boatyard would expect a cost of approximately $19,000 per year for sewer charges plus any pretreatment costs necessary to meet the local benchmarks/limits. Seattle/King Co. has decided not to accept any new shipyard stormwater to its system.

A boatyard may have to treat the stormwater to meet a city's local limits at an additional cost.

Disposal to infiltration basin

The current permit allows stormwater disposal to an infiltration basin that is 200 feet back from the shoreline and lined with absorptive media. This option is only available for those boatyards that have suitable soils and the available space and configuration to dedicate to the infiltration basin.

The cost for this option depends on the existing drainage structure of the boatyard. For those boatyards with drainage to a central location(s) the cost involves installing pumps and pipes to move the stormwater back to the infiltration basin. It's estimated that fifty percent of the boatyards would require some regrading to collect stormwater from work areas. The infiltration basin must be excavated and lined.

Capital costs for trenching, plumbing, and electrical are estimated at $40,800 based on the StormwateRx® data, and basin excavation and preparations are estimated at $10,000. Annual O&M is required to remove solids and replace absorptive media. This cost is also based on the StormwateRx® data at $3,000 a year. The annualized cost for disposal to infiltration basins without site improvements is $7,900.

For boatyards that will need site improvements, capital costs for regarding and repaving are taken from ARCADIS at $262,000 in addition to $20,400[14] in capital costs for trenching, plumbing and electrical. The capital cost for the infiltration basin is $10,000 for a typical boatyard. O&M costs are estimated at $3,000 for the regrading and repaving, $1,900 for trenching, plumbing and electrical, and $3,800 for the basin. The annualized cost for disposal to infiltration basin when site improvements are necessary is $36,800.

[13] King County Industrial Waste, Doug Hilderbrand, Industrial Waste Compliance Investigator III.

[14] Ecology assumes this is half of the capital cost for infiltration basins without site improvements because trenching and repaving are already accounted for in the Arcadis site improvements capital costs.

Stormwater treatment and discharge

Catch basin inserts

Enhanced filtration media is placed in the catch basin as an insert. The media particle size must be relatively coarse to handle peak flow and to avoid rapid clogging. Because of the limited size of most catch basins, the media insert will be relatively small. Consequently, the contact time of the stormwater with the media will be very short, further limiting metal removal.

These treatment devices removed 20 to 50 percent of the effluent copper and 60to80 percent of the effluent zinc in a bench-scale test. This would result in median effluent concentrations of 80 to 50 µg/L total copper based on current boatyard stormwater discharge data. However, this study was performed in 1997 by Hart Crowser and Ecology is hopeful that these devices have improved over twelve years. One boatyard is currently testing a new design in catch basin inserts.

Hart Crowser (1997) examined catch basin inserts with regenerable and non-regenerable (replaceable) media. They estimated the cost for a 5-acre shipyard with 17 catch basins. From observation, Ecology believes that 17 catch basins for a 5-acre boatyard is a very high estimate. Therefore, Ecology assumes a small 2-acre boatyard would only need to install 3 catch basins[15]. Costs were brought up to 2009 dollars[16] to $9,000 per catch basin a year with O&M costs of $2,700. Ecology used a 7 percent interest rate and Hart Crowser estimated catch basins to have a 10-year project life. Therefore, the annual cost for a 2-acre boatyard with 3 catch basins is $10,900 if no site improvements are necessary.

If a boatyard needs site improvements, costs were taken from the ARCADIS data of $262,000 in capital costs and $3,000 a year in O&M, added to the above costs for catch basins, this is an annual cost of $48,400 a year.

StormwateRx® Aquip

StormwateRx® is a passive, adsorptive filtration technology designed for reduction of stormwater pollutants such as suspended solids, turbidity, heavy metals, and oils from stormwater. StormwateRx® uses a pre-treatment chamber followed by a series of inert and adsorptive filtration media to trap pollutants. Pollutant removal within the pre-treatment chamber occurs by gravity settling, and pollutant removal in the filtration chamber occurs through a combination of chemical complexing, adsorption, micro-sedimentation, and filtration.

StormwateRx® is a relatively new treatment device and the cost for installation, O&M and the necessity for site improvements are still evolving. Ecology has data on StormwateRx® from three different sources:

1. ARCADIS (2008) Boatyard Stormwater Treatment Technology Cost Analysis
2. StormwateRx® data from installation at seven boatyards
3. Pacific Fisherman Shipyard & Electric, LLC Engineering Report

[15] Based on Ecology Water Quality staff estimates and observations.

[16] U.S. Department of Commerce: Bureau of Economic Analysis. Gross National Product: Implicit Price Deflator. http://research.stlouisfed.org/fred2/data/GNPDEF.txt

ARCADIS

The ARCADIS (2008) report separates costs into two parts. One is site improvements for regrading the boatyard and installing catch basins. For those boatyards that are already graded to catch basins, the cost is primarily installing and maintaining the treatment device. There are three cost scenarios:

1. Boatyards, which do not need any site improvements, would pay $91,000 in capital costs and $14,000 in O&M costs per year, which is a net present value of $219,000. This is an annualized cost of $22,600.
2. Boatyards able to get a loan to cover costs of $353,000 for necessary site improvements and $17,000 annually for O&M, would pay an annualized cost of $52,000 in loan repayments.
3. Boatyards would pay capital costs with their own cash, and boatyards must come up with $353,000. This could be a prohibitively large cost to boatyards with limited or no access to credit.

Boatyards requiring significant site improvements would pay the cost for the treatment technology ($91,000 in capital costs and $14,000 in O&M), in addition to an estimated $262,000 in capital costs and $3,000 a year in O&M, which is a net present, value of $290,000.

StormwateRx®

StormwateRx® has provided Ecology with data from seven installations it has completed at Puget Sound boatyards over the past few years. The annualized costs range from $11,000 to $23,600 and average $15,900. Ecology believes that since this data came from actual boatyard installations, it is the most accurate and is therefore weighted doubly against the other data sources. It appears from the information submitted that all seven boatyards already had catch basins and therefore did not need significant site improvements.

Pacific Fisherman

The Pacific Fisherman Engineering Report was prepared by CH2M Hill (2008). The data given was for a 0.5-acre boatyard and therefore costs were doubled to get a per acre estimate and then doubled again for a 2-acre boatyard. Capital costs are $202,400 with $13,100 in annual O&M for annualized cost estimates at $65,000.

The table below is a summary of all the data Ecology currently has for the enhanced filtration stormwater treatment system StormwateRx®. Costs for Pacific Fisherman and ARCADIS are level 1 estimates with an expected accuracy of +/-50 percent, therefore the StormwateRx® data has been weighted by a factor of two. The Net Present Value (NPV) is based on a 15-year project life using a 7 percent discount rate. None of the costs below includes site improvements.

Table 13: Summary of Varied Reported Costs for StormwateRx® without Site Improvements

Data Source	Capital Cost/Acre	O&M per year	NPV	Annualized Costs/Acre	Annualized Costs for a 2-Acre Boatyard
StormwateRx® 1	$51,000	$1,500	$64,700	$6,600	$13,200
StormwateRx® 2	$43,000	$3,000	$70,300	$7,200	$14,400
StormwateRx® 3	$51,000	$2,700	$75,600	$7,800	$15,600
StormwateRx® 4	$35,000	$2,100	$54,100	$5,500	$11,000

Data Source	Capital Cost/Acre	O&M per year	NPV	Annualized Costs/Acre	Annualized Costs for a 2-Acre Boatyard
StormwateRx® 5	$28,000	$4,800	$71,700	$7,400	$14,800
StormwateRx® 6	$52,000	$4,200	$90,300	$9,300	$18,600
StormwateRx® 7	$60,000	$6,000	$114,600	$11,800	$23,600
StormwateRx® Avg.	$45,700	$3,500	$77,300	$7,900	$15,900
Pacific Fisherman	$202,400	$13,100	$316,900	$32,500	$65,000
Arcadis	$46,000	$7,000	$110,000	$11,300	$22,600
Weighted mean	$55,500	$4,300	$94,300	$9,700	$19,400

Based on the above data, annualized costs for boatyards range from $11,000 to $65,000 per year with a weighted mean of $19,400 per year if no site improvements are needed. Below is the estimate for StormwateRx® when site improvements are necessary.

Table 14: Costs for StormwaerRx®with Site Improvements

Data Source	Capital Cost/Acre	O&M per year	NPV	Annualized Costs/Acre	Annualized Costs for a 2-Acre Boatyard
ARCADIS- Treatment Technology Cost	$46,000	$7000	$255,000	$26,000	$38,800 - 52,000
ARCADIS- Site Improvement Cost	$131,000	$15,000			

In the ARCADIS report, site improvements contribute to approximately one-half of the total cost to install a stormwater treatment technology. Therefore, the weighted mean from Table 13 was doubled to get the low range for boatyards requiring site improvements. According to the ARCADIS report, boatyards have a wide range of site improvement needs from minimal to significant and therefore a typical boatyard was assumed to require significant improvements on 50 percent of the site area. The size and area requiring drainage improvements for the typical boatyard was based on a survey of 12 representative boatyards. The largest variable in the costs presented is the extent of site improvements required at each boatyard. The actual portion of the total area requiring improvements at each boatyard will range from 0 percent to more than 50 percent. An engineering design will be required to determine that actual extent of site improvements required. Therefore, the ranges Ecology presents here are based on no site improvements needed (0 percent) and what we expect a typical boatyard will need (50 percent).

Enclosing hull refinishing work

Some boatyards may consider enclosing the hull refinishing work in temporary or permanent structures. Some boatyards are already using temporary structures for convenience. These are typically mobile structures, although they may be set on some type of foundation and be semi-permanent. These are typically metal tubing framed structures covered with heavy gauge plastic sheeting or rubberized fabric. These building are sometimes installed without local building permits because they don't meet local codes for factors such as snow loading. It's not clear that these structures will allow compliance with proposed benchmarks/limits. If pressure washing is conducted at an outside pad, then copper will deposit in the surrounding area. If the structures are mobile, there will be copper deposition on the tarmac going into stormwater when the structure is moved.

Based on comments received, a typical temporary building would need to be 24 feet wide, 70 feet long and 48 feet high. Structures this large cannot be purchased off the shelf and must be custom made. Based on an estimate from Rubb USA a structure this large would cost $133,000 to $200,000 depending on wind loading. Rubb USA expects the frames of the structures to last 50 years and the fabric to last about 25 years. Comments suggest a boatyard would need 5 of these buildings as well as a hydraulic yard trailer in order to move boats in and out of the building. Current market price is $175,000 to $250,000 depending on model and is expected to last 10 years.

According to comments, if sailboats are serviced, it will cost an additional $850 per sailboat to pull and restep every mast. One boatyard reported it would need to pull the mast on 900 sailboats if it were to use this option. Therefore, Ecology estimates the costs for a range of 0-900 sailboats. Table 15 shows the annual cost per structure as well as if 5 structures are needed.

Table 15: Annualized Cost for Enclosing Hull Refinishing Work

	Annualized Cost per Structure	Cost for 5 Structures
0 Sailboats	$40,500	$202,000
900 Sailboats	$805,000	$4,000,000

Ecology believes this option is likely infeasible on its own due to the high cost and therefore is not included in the Earnings Test analysis.

The current permit allows a boatyard to request to be removed from the *General Permit for Boatyards* if hull work is conducted inside a building. This doesn't apply to mobile structures. A boatyard removed from the *General Permit for Boatyards* would still be required to be covered under the *Industrial General Permit*.

Annual costs

ARCADIS (2008) estimates that half of the boatyards will need site improvements. Therefore, Table 16 shows the annualized cost of each treatment technology when site improvements are not needed and when they are. Enclosing hull work does not require site improvements. :

Table 16: Annualized Costs of Treatment Technologies with and without Site Improvements (2-acre boatyard)

Treatment Technology	Annualized Cost without Site Improvements	Annualized Cost with Site Improvements
BMPs	**$0**	**$0**
Disposal to Municipal Sewage	**$19,000**	**$38,000**[17]
Disposal to Infiltration Basin	**$7,900**	**$36,800**
Stormwater Treatment		
Catch Basins Inserts[18]	**$10,900**	**$48,400**
StormwateRx® (mean)	**$19,400**	**$38,800 - $52,000**

[17] For lack of other data on site improvement costs for Disposal to Municipal Sewage, costs have been doubled based on Arcadis which reports that site improvements will contribute to approximately one-half of the total cost.

[18] Final Report Shipyard AKART Analysis for Treatment of Storm Water. Prepared by Hart Crowser May 7, 1997 for Maritime Environmental Coalition. Seattle, WA. Prices have been adjusted to 2009 dollars.

Earnings test

The earnings test is the most accurate plant-level BAT test. The earnings test analyzes a plant's earnings before taxes (EBT) and determines if EBT would be positive after installation of pollution control equipment.

To perform the earnings test, calculate:

- Earnings before taxes (EBT) minus the annual cost of proposed BAT technology.

To account for a facility's ability to increase prices on their services Ecology performed the Earnings Test based on the assumption that annual sales will increase ten percent. Both scenario formulas are shown below:

1. = (Annual Sales + 10% Annual Sales) x (5.1% Operating Income Margin) – Treatment Cost
2. = (5.1% Annual Sales) + (10% Annual Sales) – Treatment Cost

If this number is:

- Greater than zero, the proposed BAT treatment technology is economically achievable
- Less than zero, the proposed BAT treatment technology is not economically achievable
- Equal to zero, the test is inconclusive.

Earnings test results

Scenario 1: Industry profit margin

Tables 17 - 20 are the results when sales increase 10 percent and only the industry profit margin (5.1 percent) of the increase can be used for profit and applied to treatment. Table 17 shows facility results of the earnings test when site improvements are not needed. Table 18 shows the results when site improvements are necessary. These tables are based on the 72 boatyards for which we had economic data. As expected, the results show that the more expensive the treatment technology is, fewer boatyards are able to pass the test. The results shown in this scenario are equal to results if no increase in sales is assumed.

Table 17: Earnings Test Results without Site Improvements Using Industry Profit Margin

	Annualized Treatment Cost	Economically Achievable[19]	Not Economically Achievable
BMPs	$0	72	0
Disposal to Municipal Sewage	$19,000	55	17
Disposal to Infiltration Basin	$7,900	64	8
Stormwater Treatment			
Catch Basin Inserts	$10,900	64	8
StormwateRx®	$19,400	55	17

[19] Ecology has included facilities that pass the Earnings Test, as well as facilities that have already installed this treatment.

Table 18: Earnings Test Results with Site Improvements Required Using Industry Profit Margin

	Annualized Treatment Cost	Economically Achievable	Not Economically Achievable
BMPs	$0	72	0
Disposal to Municipal Sewage	$38,000	44	28
Disposal to Infiltration Basin	$36,800	45	27
Stormwater Treatment			
Catch Basin Inserts	$48,800	39	33
StormwateRx®	$38,800 - $52,000	35 - 44	28 - 37

Tables 19 and 20 extrapolate the results to the total 88 currently permitted boatyards under the General Permit for Boatyards.

Table 19: Earnings Test Results without Site Improvements Extrapolated to 88 Boatyards Using Industry Profit Margin

	Annualized Treatment Cost	Economically Achievable	Not Economically Achievable
BMPs	$0	88	0
Disposal to Municipal Sewage	$19,000	67	21
Disposal to Infiltration Basin	$7,900	78	10
Stormwater Treatment			
Catch Basin Inserts	$10,900	78	10
StormwateRx® Avg.	$19,400	67	21

Table 20: Earnings Test Results with Site Improvements Extrapolated to 88 Boatyards Using Industry Profit Margin

	Annualized Treatment Cost	Economically Achievable	Not Economically Achievable
BMPs	$0	88	0
Disposal to Municipal Sewage	$38,000	54	34
Disposal to Infiltration Basin	$36,800	55	33
Stormwater Treatment			
Catch Basin Inserts	$48,400	48	40
StormwateRx®	$38,800 - $52,000	43 - 54	34- 45

Scenario 2: All increase is profit

Tables 21 - 24 are the results when sales increase by 10 percent but the entire increase can be used as profit and applied to treatment. Table 21 shows facility results of the earnings test when site improvements are not needed. Table 22 shows the results when site improvements are necessary. These tables are based on the 72 boatyards for which we had economic data.

Table 21: Earnings Test Results without Site Improvements Using all Increase as Profit

	Annualized Treatment Cost	Economically Achievable	Not Economically Achievable
BMPs	$0	72	0
Disposal to Municipal Sewage	$19,000	64	8
Disposal to Infiltration Basin	$7,900	72	0
Stormwater Treatment			
Catch Basin Inserts	$10,900	71	1
StormwateRx®	$19,400	65	7

Table 22: Earnings Test Results with Site Improvements Required Using all Increase as Profit

	Annualized Treatment Cost	Economically Achievable	Not Economically Achievable
BMPs	$0	72	0
Disposal to Municipal Sewage	$38,000	61	11
Disposal to Infiltration Basin	$36,800	61	11
Stormwater Treatment			
Catch Basin Inserts	$48,800	55	17
StormwateRx®	$38,800 - $52,000	55 – 61	11 – 17

Tables 23 and 24 extrapolate the results to the total 88 currently permitted boatyards under the current *General Permit for Boatyards*.

Table 23: Earnings Test Results without Site Improvements Extrapolated to 88 Boatyards Using all Increase as Profit

	Annualized Treatment Cost	Economically Achievable	Not Economically Achievable
BMPs	$0	88	0
Disposal to Municipal Sewage	$19,000	78	10
Disposal to Infiltration Basin	$7,900	88	0
Stormwater Treatment			
Catch Basin Inserts	$10,900	87	1
StormwateRx® Avg.	$19,400	79	9

Table 24: Earnings Test Results with Site Improvements Extrapolated to 88 Boatyards Using all Increase as Profit

	Annualized Treatment Cost	Economically Achievable	Not Economically Achievable
BMPs	$0	88	0
Disposal to Municipal Sewage	$38,000	75	13
Disposal to Infiltration Basin	$36,800	75	13
Stormwater Treatment			
Catch Basin Inserts	$48,400	67	21
StormwateRx®	$38,800 - $52,000	67 – 75	13 – 21

Conclusion

The above data shows that treatments will be much more economically achievable if boatyards are able to increase their prices and use that increase entirely as profit. In that case, boatyards could use all of their sales increase towards installing a treatment. Boatyards responding to a draft of this report commented they do not believe in the current economy they will be able to raise prices; however we did not want to ignore the possibility of passing costs onto consumers and have used 10 percent as our best estimate. To make the analysis applicable at any time, we have presented both scenarios.

Sources

ACADIS Kellems, Barry. June 27, 2008, *Boatyard Stormwater Treatment Technology Cost Analysis.* Prepared for Northwest Marine Trade Association, Puget Soundkeeper Alliance, and Washington State Department of Ecology.

BusinessWeek "Small Business Rate Report" http://www.businessweek.com/smallbiz/resources/rate_report/borrowers.htm (March 2009)

CH2M Hill Farmer, Bill. December 23, 2008. *Pacific Fisherman Shipyard Industrial Stormwater Treatment System AKART Evaluation*. Prepared for Pacific Fisherman Shipyard & Electric, LLC.

First Research, 2009. Industry Profile for *Shipbuilding and Repair.* www.firstresearch.com

HartCrowser, 1997. *Final Report Shipyard AKART Analysis for Treatment of Storm Water*.

StormwateRx® Noling, Carl P. July 31, 2009. *Actual Cost and Performance for Boatyard Full Scale Stormwater Treatment BMPs.* Prepared for Washington Department of Ecology.

Water Quality Program Permit Writer's Manual. Revised July 2008. Washington State Department of Ecology Publication Number 92-109, Chapter IV, pages IV-1 to IV-74.

Appendices

Appendix A

Vacuum Sanding Cost Analysis - Dustless Sanding Saves Money and Keeps Water Clean

In 1998, the Washington Department of Ecology, with the assistance of the Puget Soundkeeper Alliance, conducted a pilot project to assess all costs and environmental performance of two different bottom paint removal technologies. This demonstration project was co-sponsored by Mr. Neil Falkenburg of West Bay Marina, in Olympia, Washington. One side of the bottom of the project vessel was prepared with a vacuum sander while the other side was prepared with a traditional air rotary grinder. Then costs were compared.

The purpose of the demonstration was to determine if there were economic incentives to adopting dustless sanding technology in addition to the obvious environmental benefits. The NPDES Boatyard General permit is designed to control the release of pollutants into surface waters. The permit states:

When stripping, sanding, scraping, grinding, sandblasting, painting, coating and/or varnishing any portion of a vessel, all particles, oils, grits, dusts, flakes, chips, drips, sediments, debris and other solids shall be collected and managed to prevent their release into the environment and entry into waters of the state. Drop cloths, tarpaulins, structures, drapes, shrouding or other protective devices shall be secured around the vessel to collect all such material. The cleanup of all collected materials shall be routinely undertaken to prevent their release into the environment and entry into waters of the state. The use of vacuum sanders is recommended as a means to greatly reduce the amount of particulate released into the environment.

The cost assessment conducted found boaters using vacuum sanders to prepare the bottom of a 32-foot sailboat for repainting could save $235 in material costs over the air rotary tool. The economics are different for the boatyard than for an owner working on his boat. The boatyard must purchase the equipment. The Fein vacuum extractor 9-55-13 costs $250 and the Fein MSf 636-1 power head costs $535, for a total system cost of $785. The material cost savings on this project were $170. The system could be paid off in as little as five jobs. If the boatyard rented

out the equipment at a rate of $50 per day, the system could be paid for in 16 rental days. If the purchase of the system coincided with the peak work season, the cost of the entire system could be recovered in just over two weeks.

Vacuum Sander	Traditional Air Rotary Tool
	
Need only dust mask and eye protection.	Need respirator and protective coveralls.
Sander safer and comfortable to use.	Safety equipment difficult to work in
Need only drop cloth	Need drop cloth and plastic shrouding
Clean with dust completely contained in filterbag	Messy with large volume of solid wastes generated.
98% dust-free, certified for lead abatement work.	More paint dust escapes due to positive pressure.
Sanding Pads last longer and plug less.	Sanding pads gum up rapidly
Labor - $900.	Labor - $800
Material - $188 ($54 for boatyard)	Materials - $424 ($224 for boatyard.)
Total Costs - $1088	Total Costs - $1224

Discussion

All work was performed by qualified boatyard personnel and assigned a flat rate of $50 per hour. Boatyard permit requirements for tarping and shrouding were strictly adhered to. Material costs included duct tape, visqueen, sanding pads, filter bags, safety equipment and rental costs.

Standard rental rates were used for equipment and respirator. Time to locate and rent equipment was not included. Labor costs were similar, but vacuum sanding took slightly longer at 18 hours verses 16 hours. This was attributed to the size difference between the 6" vacuum sander pad and the 8" disc of the air rotary tool. There were significant material savings with the vacuum sander. This was a result of 168 fewer sanding pads gumming up with melted paint from frictional heat and less plastic and tape needed to shroud the vessel, in accordance with permit requirements. Copper found in bottom paints is a major pollutant in stormwater runoff from boatyards; and a contaminant of marinas. The safe copper levels for our waters are in the low parts per billion while the copper in stormwater is measured in parts per million. The biggest problem is the do-it-yourself-er that walks away from a sanding job and leaves the mess to be blown by the wind or washed away by the rain. It makes no sense to spread the paint dust on the ground only to have to pick it up again. The volume of solid waste generated to contain the mess costs money to collect and dispose of. Vacuum sanders put 98 % of the dust immediately into a filter bag, out of the elements and off others boats. (from Ship Shape, Ecology Publication No. 99-16)

PORTABLE VACUUM SANDING SYSTEM

Revision Date: 5/03
Process Code: Navy/Marines: IND-010-04, IND-015-12, IND-010-99, ID-03-99; Air Force: ST01, ST04; Army: DPT
Usage List: Navy: High; Marines: Medium; Army: Medium; Air Force: Medium
Alternative For: Chemical stripping; hand and mechanical sanding to remove paint from composite structures
Compliance Impact: Medium
Applicable EPCRA Targeted Constituents and CAS Numbers:
Lead (CAS: 7439-92-1), Chromium (CAS: 7440-47-3), Zinc (CAS: 7440-66-6), Toluene (CAS: 108-88-3), Xylene (CAS: 1330-20-7), Methyl ethyl ketone (CAS: 78-93-3), Acetone (CAS: 67-64-1), n-Butyl alcohol (CAS: 71-36-3), Phenol (CAS: 108-95-2), Chloroacetic acid (CAS: 79-11-8), and Dichloromethane (CAS: 75-09-2)

Overview:

A portable vacuum sanding system will effectively capture sanding residue and be mobile/light enough to be operated by one person. The unit can be used to sand composite structures such as radomes. The system integrates a vacuum cleaner with vacuum assist sanders for eliminating airborne toxins (including lead, chromium, and dust) while removing paint from both metallic and nonmetallic aircraft structures. The system incorporates three-stage filtration composed of a filter bag, prefilter, and HEPA filter. The effect this technology has on pollution prevention is that the portable vacuum sander removes coatings and corrosion from composite or metal structures while capturing the solid waste. Vacuum sanding eliminates airborne particulate matter and potential lead dust exposure hazard. When compared to chemical paint stripping, this technology eliminates the generation of waste solvent.

OSHA 1910.1025 requires that sanding and grinding operations take place without exceeding the lead permissible exposure limit (PEL) of 50 g/m3. The vacuum sander helps meet this requirement. OSHA 1910.1025 states: "Where vacuuming methods are selected, the vacuums shall be used and emptied in a manner which minimizes the reentry of lead dust into the workplace." Therefore workers should exercise care when using and emptying vacuum units. An example of one system is the Clayton cleaner/sanding system Model 660-DM-1000. This system incorporates one vacuum cleaner, two vacuum assist sanders, two vacuum assist grinders one package of 6 mil polyliners, one Y adapter, one package of filter bags, two packages of prefilters, and one tool caddy. All accessories are compatible with each other. In 1994, the Navy procured approximately 124 units for use on both shore-based and shipboard activities. In addition, several Air Force bases use the units. Currently, several vacuum sanding units are being used on composite radomes at Naval Station Mayport in Florida, but evaluation of the system is not complete.

Compliance Benefit:

The portable vacuum sanding system eliminates the generation of waste solvent when compared to chemical stripping. This benefit may help facilities meet the requirements of waste reduction under **RCRA, 40 CFR 262; the Pollution Prevention Act (42 USC 13101-13109); and Executive Order (EO) 13148**, *Greening the Government Through Leadership in Environmental Management*; and may also help facilities reduce their generator status and lessen the amount of regulations (i.e., recordkeeping, reporting, inspections, transportation, accumulation time, emergency prevention and preparedness, emergency response) they are required to comply with under **RCRA, 40 CFR 262**. It should be noted that the portable vacuum sanding system generates slightly more hazardous waste when compared to traditional hand sanding, but this factor may be counterbalanced by reduced employee exposure benefits. In addition, less hazardous materials (i.e., solvent) are required to be purchased and stored on site and therefore the possibility that the facility would meet any of the reporting thresholds of SARA Title III (**40 CFR 300, 355, 370, and 372**) is decreased.

The compliance benefits listed here are only meant to be used as general guidelines and are not meant to be strictly interpreted. Actual compliance benefits will vary depending on the factors involved, e.g., the amount of workload involved.

Materials Compatibility: The system can be used in most applications where chemical stripping, hand sanding, and mechanical sanding methods are used. No materials compatibility issues were identified.

Safety and Health: Airborne dust is a major safety and health concern with any sanding operations and can be essentially eliminated by using the vacuum sanding system. However, eye protection and hearing protection are recommended. The system is designed to be in compliance with **OSHA 1910.1025** for use during sanding and grinding operations.

Consult your local industrial health specialist, your local health and safety personnel, and the appropriate MSDS prior to implementing this technology.

Benefits:

- Reduces airborne pollution from current power sanding operations.
- Improves efficiency of operations.
- Improves personnel safety by collecting and containing paint dust particles.
- Provides a cost-effective means to remove paint from composite structures that cannot be removed from a ship.
- Reduces labor hours for manual sanding operations. z Portable unit.

Disadvantages:

- Capital equipment investment is required.
- Operator training is necessary.
- Operator time, maintenance requirements, handling, and disposal of waste varies with the material to be stripped.

- Quality of stripping is dependent on skill and experience level of the operator. Composite substrate can be damaged.

Economic Analysis: Processing radomes and equivalent composite structures using the vacuum sanding system has shown some decrease in process time for a radome assembly. However the largest benefit is personnel safety. The vacuum and filtration process eliminate airborne toxins (including lead, chromium, and dust) generated when preparing coated surfaces for refinishing. The vacuum sanding system interfaces well with site operations, minimizes site clean-up, and provides a safer, healthier work environment.

Assumptions:

- Labor for sanding and grinding is the same for either system.
- Number of sanding disks or wheels is the same for either system.
- Filter bags are changed once per month taking 5 minutes.
- Prefilters are changed once per year taking 5 minutes.
- HEPA filters are changed once every ten years taking 5 minutes.
- Filter bags cost $9; prefilters cost $18; HEPA filters cost $369.
- Labor rate = $40/hr.
- Setup/Cleanup for conventional sanding/grinding operation takes 80 hrs/yr.
- Setup/Cleanup for vacuum sanding takes 40 hrs/yr.
- Waste disposal quantities are slightly higher for vacuum sanding because of the disposal of filters.
- Waste disposal costs $1,200/ton or $0.60/lb.
- 500 lbs. of waste material from sanding operations are generated/year.
- 25 lbs. of filters are generated/year.

Annual Operating Cost Comparison for Portable Vacuum Sanding and Conventional Sanding

	Conventional Sanding	**Portable Vacuum Sanding**
Equipment Cost	$0	$4,955
Operational Cost		
Setup/Cleanup Labor	$3,200	$1,600
Maintenance Labor (changing filters)	$0	$43
Filter Purchases	$0	$163
Disposal	$300	$315
Total Operational Costs	$3,500	$2,121
Total Cost	$3,500	$7,076

Economic Analysis Summary:

- Annual Savings for Vacuum Sanding: $1,379
- Capital Cost for Equipment/Process: $4,955
- Payback Period for Investment in Equipment/Process: 3.6 years

Vendors: This is not meant to be a complete list, as there may be other suppliers of this type of equipment.

- Clayton Associates, Inc
  Farmingdale, NJ 07727
  Phone: (800) 248-8650
  Service: Dustmaster System Model 660-DM-1000

- Nilfisk, Advanced America, Inc.
  300 Technology Drive
  Malvern, PA 19355
  Phone: (800) 645-3475
  URL: http://www.nilfisk-advance.com/

- Tiger-Vac Inc.
  14 Healey Ave. Plattsburgh, NY 12901
  Contact: Mr. Massimo De Pastena
  Government Sales Phone: (800) 668-4437 ext. 226
  FAX: (800) 668-4439
  URL: http://www.tigervac.com
  Service: Industrial vacuum sanding kits and industrial vacuum cleaners

Sources:

- Mr. Massimo De Pastena, Tiger-Vac Inc., September 2002.
- Mr. Jim Clayton, Clayton Associates, Inc., March 1997.
- Mr. Chris Mahendra, Naval Air Warfare Center, Aircraft Division, March 1997.

Supplemental:

Picture of Portable Vacuum Sanding System – Environmental Quality Initiative

Vacuum Sanding Requirements

Sander:

- 98% dust extraction
- Suitable for lead abatement work
- Electric or air powered

Vacuum:

- Static water lift = 60 inches minimum
- Air flow = 116 cfs minimum
- Power = 900 watts minimum
- Filter = 1 micron cartridge minimum
  - Recommended = 5 micron bag filter, plus a 1 micron cartridge filter, plus a 0.5 micron filter

Appendix B (from Ecology Publication 92-500)

BAT Economic Reasonableness Test

BAT is Best Available Technology Economically Achievable and is applicable to toxics and non-conventional pollutants.

In setting BPJ effluent limits for BAT treatment technologies, 40 CFR 125.3(d)(3)(v) states that "the cost of achieving such effluent reduction" must be considered. This regulation repeats a portion of section 304(b)(2) of the Clean Water Act, which defines BAT. Even though the CWA does not list pollution reduction benefits among the factors that must be considered in determining BAT, they are considered by EPA when determining BAT. Therefore, the relationship between the cost of BAT and the pollution reduction achieved by the installation of BAT is also considered. An EPA permit writing expert has defined the cost of achieving the effluent reduction as the capital and operating cost of attaining a specified effluent quality.

The CWA does not require a comparison of costs and benefits. EPA writes:

"The statutory assessment of BAT "considers" cost, but does not require a balancing of costs against pollution reduction benefits...In developing the BAT limitations, however, EPA has given substantial weight to the reasonableness of costs. The Agency has considered the volume and nature of discharges, the volume and nature of discharges expected after application of BAT, the general environmental effects of the pollutants, and the costs and economic impact of the required pollution control levels" (47 FR 23263).

Costs and benefits do not have to be compared. However, EPA does consider the cost of the pollutant reduction achieved by BAT technology in setting BAT effluent limits. Thus, it does compare costs and benefits (as measured by pollutant reduction) in determining BAT. However, economic achievability is given more weight.

With regard to the BAT economic achievability test, the U.S. Fifth Circuit Court of Appeals wrote:

> "Both Congress and the Supreme Court have made clear that in setting BAT, the EPA is not required to compare the costs against the benefits of pollution reduction in the same manner as the EPA is required to do in setting BPT standards". (p. 250, Chemical Manufacturers Association vs. USEPA)

The court also wrote that section 301(b)(2)(A), which defines BAT, differs from section 301(b)(1)(A), which defines BPT, in that it does not state that costs shall be considered in relation to effluent reduction. No cost-benefit test is required by the CWA (p. 250, Chemical Manufacturers Association vs. USEPA). In setting BAT effluent limits, EPA must only consider their "economic achievability."

BAT Economic Achievability Tests

The BAT economic achievability tests are described in federal guidelines--not in federal or state regulations. EPA's Guidance Manual for Estimating the Economic Effects of Pollution Control Costs describes these tests. EPA emphasizes that this manual is not regulation or policy. Therefore, Ecology must determine the specific methods that it will use to evaluate economic achievability and to justify those methods. Ecology could use methods other than the federal tests if it has legitimate reasons for using them.

EPA's Guidance Manual defines a treatment technology to be economically achievable if its use would not cause the plant to shut down. That is, the technology is economically achievable if its annual cost is less than the plant's annual profits.

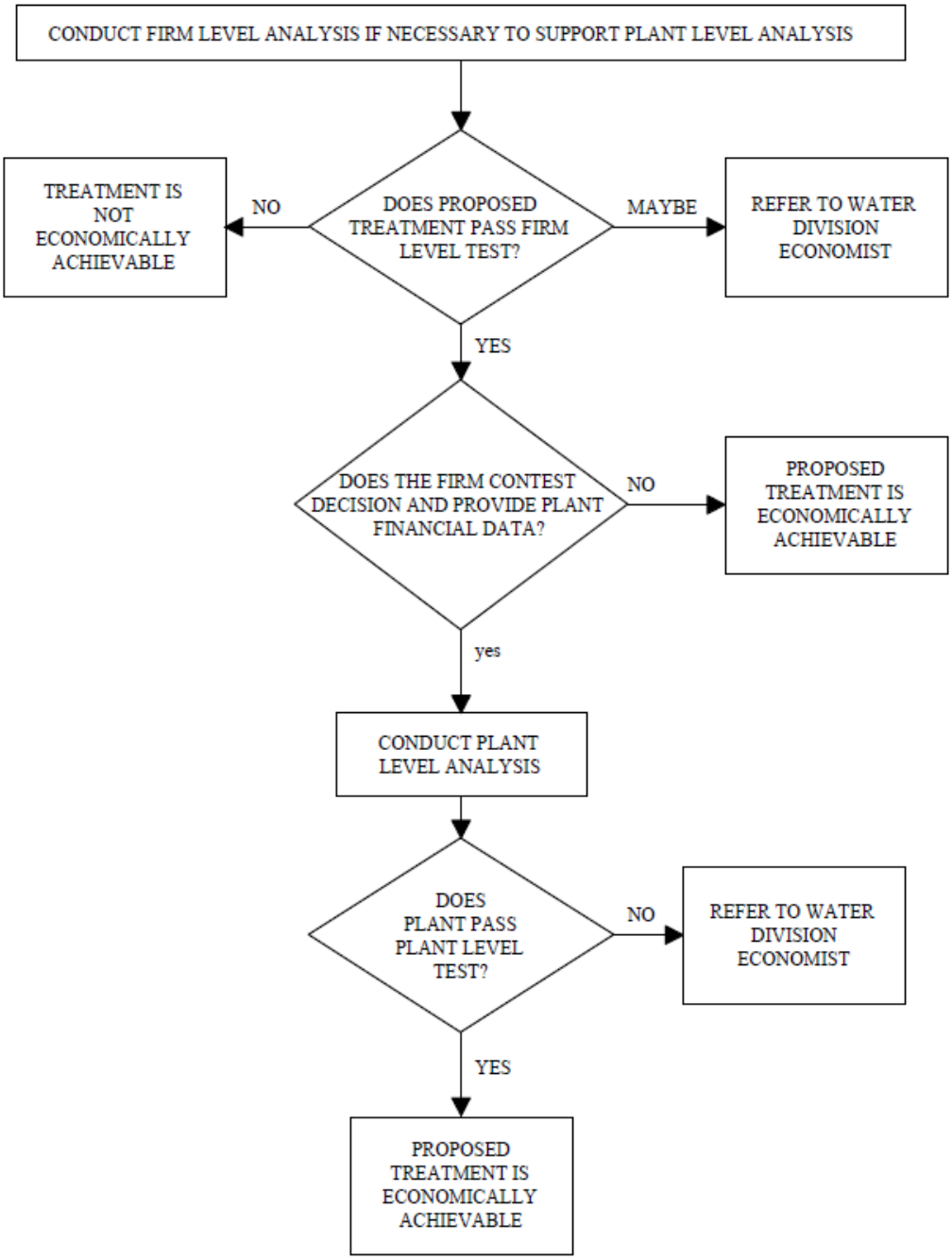
EPA's Guidance Manual uses a 3-stage approach to determining economic achievability:

1. First, perform a firm-level test.

2. If the control technology passes the firm-level test, but the permit holder protests that the technology is not economically achievable, then perform a plant-level test.

3. If the firm-level test is inconclusive, then a plant closure analysis must be conducted.

Figure IV-4. Sequence of Analysis for Determining Economic Achievability for BAT.



The plant-level test makes the most sense economically. It is more precise than the firm-level test. However, plant-level tests are difficult to do because plant-level data is limited and confidential. Therefore, the Guidance Manual recommends doing the firm-level test first because, in some cases, it is possible to conduct it with publicly-available data on the firm's balance sheet, income statement, and stock prices.

However, in most cases it is either impossible or a waste of time to perform the firm-level test for 2 reasons:

1. For most permit holders, the firm-level test is difficult to do because few of them are publicly held corporations. Therefore, no publicly available balance sheet or stock market data exists. In many cases, because the firm is so small, the firm will equal the plant.

2. Any permit holder with any business sense will demand that the plant-level economic achievability test be performed in any case, because he/she, as a profit-maximizer, is interested in the profitability of the plant. A profit-maximizing firm owner has no interest in subsidizing the wastewater treatment costs of one plant with profits earned by the remainder of his/her firm.

The primary justification for conducting the firm-level test is that the data needed to perform the test is publicly available from sources such as Moody's Industrial Manual and from stock prices. However, very few Washington permit holders (especially small- and medium-sized companies) are publicly owned. Thus, few have stock that is publicly traded. Few permit holders are listed in Moody's and similar publications. There is no other publicly available data. Therefore, for these firms, permit holders must provide the data needed to conduct firm-level tests.

In cases where the firm is identical to the plant, a plant-level test is the same as a firm-level test, therefore, call it a plant-level test.

Even when there is publicly available data, a firm-level test will usually yield a meaningless answer that will be immediately disputed by the permit holder. There is little point in estimating the impact of the annual cost of a proposed BAT treatment system for a Weyerhaeuser plant on the total worldwide profits of the Weyerhaeuser Co. It is obvious that the impact will be tiny. It is also obvious that Weyerhaeuser will immediately point out that it is concerned with the profitability of each of its facilities and is not interested in subsidizing one plant with profits from its other plants. Therefore, it will want a plant-level test to be conducted.

Generally the firm-level test should not be conducted except in the situation discussed below where it is used to compliment the plant-level test.

Firm-Level Test

The firm-level test examines whether the firm as a whole can afford the treatment technology. It is performed using publicly available balance sheet and stock market data.

There are 7 different firm-level tests. They all estimate the impact of the cost of pollution control equipment on a financial ratio. Among the tests are: the current ratio, which is the ratio of current assets to current liabilities; Beaver's ratio, which is the ratio of cash flow to total debt; the debt/equity ratio; and the market-to-book ratio.

The Guidance Manual suggests that if the firm-level test shows that the proposed BAT treatment technology is not economically achievable for the firm, then it is not economically achievable for the plant. This is not always true because the firm-level test may give misleading results. It is possible that the plant is making large profits, while the firm as a whole has low profits. Losses in some of the firm's plants offset profits in others. In such a situation, the firm-level test would indicate that the proposed BAT technology is economically unreasonable, when, in fact it was reasonable.

If the firm-level test shows that the proposed BAT treatment technology is economically achievable, the owner may contest this determination. The owner may contend that the BAT technology will make the plant unprofitable to operate. If the determination is contested, the owner must provide plant-level data for the plant-level test.

In some cases (especially when the permit holder has only one plant), the firm-level tests can be used to supplement the plant-level test. They can provide information that the plant-level test does not. In most cases the data needed to perform the firm-level tests will have to be provided by the permit holder. Because there are several firm-level tests and because performing them is complicated, instructions for conducting them are not included here. See the Guidance Manual for instructions.

As explained earlier, in most cases the firm-level test is meaningless and will probably be disputed by the permit holder. In addition, for many firms, balance sheet and stock price data which is required to perform the firm-level test is not publicly available. Therefore, the firm level test should only be performed to compliment the plant-level test.

Plant-Level Test

There are 3 plant-level tests. All the plant-level tests ask the same question: would the plant's earnings before taxes be greater than zero if it installed the proposed BAT technology? That is, would the plant be driven out of business by the cost of the BAT technology?

The 3 plant-level tests are:

1. Earnings test
2. Gross margin test
3. Revenue test

According to EPA, only 1 of the plant-level tests needs to be done because the 3 tests are essentially the same, differing only in the amount of data that they require the firm to provide. The three tests require data from the plant's income statement and estimation of the annual cost of the proposed BAT treatment technology.

It is important to note that all three of the BAT plant-level economic achievability tests are conservative. They assume that the permit holder cannot pass any portion of the cost of the BAT treatment equipment on to its customers. The cost is assumed to come completely out of its profits. The tests assume that the cost of the pollution control equipment is an additional cost but that revenue is constant. Generally, this assumption is incorrect for many of the industries that hold permits because the permit holder will be able to pass along a portion or all of the cost, thus lowering the impact of the cost of the treatment equipment on its profits. The more that water pollution control regulations are consistent throughout the U.S., the easier it is for the permit holder to pass the costs on. Therefore, this economic achievability test is biased in favor of the permit holder.

The permit holders are responsible for providing the cost, earnings, and revenue data needed to perform the economic achievability test. If they refuse to supply the data, then it should be assumed that the treatment technology is economically achievable

Plant Closure Analysis

If the plant-level tests do not provide conclusive answers, then a detailed plant closure analysis must be conducted. This is a much more detailed and therefore, more valid and expensive--examination of the impact of the cost of the treatment technology on the plant's economic viability. It is a job for a consultant.

The EPA Guidance Manual states:

The plant-level tests are intended and designed as screening tests rather than rigorous and definitive evaluations of a plant's ability to afford pollution control costs. If the test results indicate that pollution controls would impose severe economic impacts, then a more detailed plant closure analysis would be necessary. This would entail working closely with the plant and corporate accountants to gather information on a variety of costs, revenues, and accounting procedures. Information on salvage values of equipment as well as projections of future economic conditions may be desirable or required.

Data Requirements for Plant-Level Test

If the owner does not think that a treatment technology proposed by Ecology is economically reasonable and wants a plant-level test conducted, he/she must provide the data needed to conduct the economic achievability tests.

The permit holders are responsible for providing all the data needed to perform the economic achievability tests. They must supply 2 types of data:

1. Cost estimate for upgrading the treatment technology from BPT to the proposed BAT technology.

2. Data from its income statement.

Pollution Control Equipment Cost Estimate

All 3 BAT plant-level economic achievability tests require estimates of the annual cost of the proposed BAT treatment technology. This cost is the cost of upgrading from BPT to BAT treatment. For the BAT test, the total annual cost of upgrading from BPT or proposed BPT to the proposed BAT treatment technology is used. Marginal costs per unit of pollutant removed are not used in the BAT tests.

Ecology may propose a BAT treatment process based on the fact that a competitor of the permittee had a similar process. If the permittee disputes this type of comparison they must submit data to show why they are substantially different from their competitor.

The plant-level tests use before-tax annual costs.

Income Statement Data

The permit holder must provide plant-level income statement data--revenue, costs, and earnings--for the most recent 3 years (The EPA Guidance Manual only uses data from the most recent year's income statement). If it does not collect this data at the plant level, it must do the best job it reasonably can in constructing accurate income statements for the plant.

The permit holder must provide the following income statement data:

1. Revenue

2. Cost of Goods Sold
    A. Cost of materials
    B. Direct labor costs
    C. Production overhead costs (indirect labor, rent, energy, etc.)
    D. Extraordinary costs should not be included.

3. Corporate Overhead Costs Assigned to the Plant
    A. Selling, general, and administrative expense.
    B. Interest expense
    C Depreciation on common property
    D. Etc.

The permit holder must supply documentation to verify the data. For example, state excise tax returns, federal income tax returns, tax schedules, etc.

For plants that are owned by companies with several facilities, income tax returns and schedules will usually lump together the revenue, cost, and earnings data for all the facilities. In such cases, income tax forms will be worthless for verifying plant-level revenue and cost data.
Ecology will then have to rely on accounting records. Such records might be biased by the permit holder. There is little Ecology can do about this, short of auditing the firm.

There are several problems that will be faced in obtaining accurate plant-level data:

- Plant-level data is usually confidential.

- Sometimes firms do not collect plant-level revenue and cost data. Many companies do not keep revenue data at the plant level. Instead, they maintain some cost records at the plant level but record revenues at the division or firm level.

- Corporate overhead costs are not usually allocated to individual plants. And when they are, biases may exist in the allocation method.

- Non-standard accounting procedures used internally by the firm can make it difficult to verify cost and revenue data.

- Firms may bias the plant's costs and revenues. It is essentially impossible to audit the cost and revenue data for accuracy.

- Transfer prices for inputs purchased by the plant from other parts of the firm can be biased upward in order to increase costs.

- Transfer prices for goods sold by the plant to other parts of the firm may be biased downward in order to reduce revenue.

The BAT plant-level economic achievability tests are performed using the following tests which are calculated using income statement data:

- Earnings before taxes test (EBT) = revenues minus the costs of goods sold and corporate overhead

- Gross margin test = revenues minus costs of goods sold

- Revenue test

Performing the Plant-Level Tests

The earnings test is the most accurate plant-level BAT test. Therefore, if the data is available, it is the test that should be performed. The earnings test asks the question: would the plant's earnings before taxes be greater than zero if it installed the proposed BAT technology?

The earnings test analyzes a plant's earnings before taxes (EBT) and determines if the EBT would be positive after installation of pollution control equipment.

The earnings test requires data that may not normally be collected at the plant level. Therefore, its application may be limited. The gross margin test and the revenue test require less data and, therefore, can be used in more situations.

Table IV-3. The BAT Earnings Test.

EARNINGS TEST
TO PERFORM THIS TEST CALCULATE: Earnings before taxes minus the annual cost of proposed BAT technology
• If this number is greater than zero, the proposed BAT treatment technology is economically achievable. • If this number is less than zero, the proposed BAT technology is not economically achievable. • If this number is equal to zero (or near zero), then the test is inconclusive. A plant closure analysis must be carried out.

If the earnings test is inconclusive, the other 2 plant-level tests will not help to determine whether or not the proposed technology is economically achievable. All 3 tests are identical except that the gross margin and revenue test use less accurate data than the earnings test uses. Tests performed using less accurate data cannot help provide a conclusive answer when the test using the most accurate data (the earnings test) does not provide a conclusive answer.