ERDC/EL TR-11-6

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A Bibliography of Selected Literature on Indirect Impacts Associated with Clean Water Act Section 404 Permits

Timothy C. Wilder, William M. Ford, and Marie M. Perkins

July 2011

Environmental Laboratory

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Final report

Approved for public release; distribution is unlimited.

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000

Abstract: This report summarizes a review of the scientific literature from the year 2000 to the present that characterizes indirect impacts associated with Clean Water Act Section 404 permits. Also of interest was literature from 2004 forward that addresses compensatory mitigation for impacts, particularly with respect to current policy.

Literature containing derivations of the search terms "Clean Water Act," "404," "temporary fill," "dredge and fill," "impact," "secondary impact," and "cumulative impact" in the title, keyword or abstract field(s) was selected. When these searches produced few results, the number of search terms was expanded. This series of searches returned in excess of 5,500 bibliographic records. Each record's abstract was then reviewed for relevance to the Corps of Engineer's 404 permitting program and assigned to at least one of 20 groups according to the focus of that particular study. A review for relevance and assignment to groups reduced the number of records to 1,252 (approximately 10% of which were assigned to more than one group).

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Preface

This work was conducted by the Environmental Laboratory (EL), U.S. Army Engineer Research and Development Center (ERDC), for the Corps of Engineers Wetlands Regulatory Assistance Program (WRAP). Timothy C. Wilder, William M. Ford, and Marie M. Perkins compiled this report and the WRAP Program Manager was Bob Lazor, EL.

This report was prepared under the general supervision of Morris Mauney, Chief, Wetlands and Coastal Ecology Branch, EL; Dr. Edmund Russo, Chief, Ecological Evaluation and Engineering Division, EL; and Dr. Beth Fleming, Director, EL.

COL Gary E. Johnston was Commander and Executive Director of ERDC. Dr. Jeffery P. Holland was Director.

1 Introduction

Section 404 of the Clean Water Act (CWA) directs the U.S. Army Corps of Engineers (COE) to administer a regulatory program for permitting the discharge of dredged or fill material in "waters of the United States." Successful applicants for 404 permits must demonstrate that impacts have been avoided, that unavoidable impacts have been minimized, and that adequate compensation will be provided for remaining impacts (U.S. Army Corps of Engineers and Environmental Protection Agency 1990).

This three-part sequence for review of compensatory mitigation has its roots in the beginnings of the Section 404 permitting program. Indeed, the first COE 404 regulations in 1973 contained language urging permit applicants to modify proposals to eliminate or mitigate damage to aquatic resources. The concept matured over several years, requiring revisions of COE and EPA 404 regulations. This process culminated in February 1990 with the signing of the "Memorandum of Agreement Between The Department of the Army and The Environmental Protection Agency: The Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines" (Hough and Robertson 2009).

The agencies and the public recognized cumulative and indirect impacts of discharged dredged and fill material into aquatic sites at the inception of the 404 program. Despite this, the focus of the 404 program has been on direct impacts for much of its history (Hirsch 1988). Among the most important reasons for this narrow focus was the time necessary to settle interpretation of relevant law, resolve jurisdictional issues, and develop administrative process (Hough and Robertson 2009). Difficulties inherent in assessing indirect and cumulative impacts over multiple temporal and spatial scales have also been a barrier to considering them in the context of the 404 program (Brody et al. 2008; Stein and Ambrose 2001; Swenson and Ambrose 2007).

The New England District, Corps of Engineers requested a review of the scientific literature from 2000 to the present that characterizes indirect impacts associated with CWA Section 404 permits. Also of interest was literature from 2004 forward that addresses compensatory mitigation for

impacts, particularly with respect to current policy. This report is a compilation of the results of that literature review.

Methods

Literature selected contained derivations of the search terms “Clean Water Act,” “404,” “temporary fill,” “dredge and fill,” “impact,” “secondary impact,” “indirect impact,” and “cumulative impact” in the title, keyword, or abstract field(s). When these searches produced few results, the number of search terms was expanded. Table 1 lists the two categories that most of the search terms used in subsequent searches fell under.

Searches using the keywords in Table 1 returned in excess of 5,500 bibliographic records. Each record’s abstract was then reviewed for relevance to the COE’s 404 permitting program and assigned to at least one of 20 groups according to the focus of that particular study. Table 2 lists the subject groupings that were used. Review for relevance and assignment to groups reduced the number of records to 1,252 (approximately 10% of which were assigned to more than one group).

Discussion

Literature published after 2000 was found to contain relatively few studies that explicitly focused on documenting indirect or secondary impacts from a 404-permitted activity. The majority of those found were assigned to the “Cumulative Impacts” and “404 Specific” groups. The bulk of the remaining literature addresses impacts, though the author(s) may not have traced them to an activity that would ordinarily require a 404 permit. For example, a recent study conducted in Maryland and Pennsylvania documents current downstream effects of existing small impoundments on stream bed load and morphology and discusses implications to the stream in the event of their removal (Skalak, Pizzuto, and Hart 2009).

An exhaustive listing of the tremendous body of literature in some areas would have produced a great deal of duplication. Literature on wildlife, roads, road infrastructure, urbanization, water quality, wetland mitigation, and regulatory policy is extensive. Instead, studies were selected from across the United States that were judged to fully represent these subjects. Studies in the New England region were included preferentially, though a few citations of studies conducted overseas have been included when they illustrate some underlying ecological principle or mechanism that is

relevant to Section 404. Citations prior to 2000 that were believed to be especially useful were also retrieved.

Table 1. Keywords used in the literature search.

Pollutants and Effects	Activities associated with Section 404 permits	
algae	armoring	powerline
bacteria	bank stabilization	pumping
biological oxygen demand	berm	reservoir
brush	boat launching ramp	retaining wall
channel bed aggradation	borrow pit	riparian buffer
channel incision	bridge	riprap
channel widening	building	road
chemical oxygen demand	clearing	road crossing
chemicals	culvert	sewer line
debris	dam	soil harvest
erosion	development	soil mining
eutrophication	dike	soil pit
fertilizers	ditch	spoil
flooding	ditches	stream channelization
grass clippings	ditching	stream dredging
insecticides	diversion	stream encapsulation
lawn waste	drain	stream ford
litter	drainage	stream relocation
mass-wasting	easement	stream widening
metals	fill	trail
noise	filling	trenching
nutrient enrichment	flume	vegetation removal
nutrients	french drain	water diversion
pesticides	gravel/sand dredging	waters supply intake
ponding	gravel/sand harvest	water transfer
scour	gravel/sand mining	water withdrawal
sediment	green-tree reservoir	weir
sedimentation	highway	wing wall
soil compaction	impoundment	
stream capture	irrigation	
stream loss	levee	
thermal	parking lot	
trash	pipeline	
woody debris	pond	

Table 2 Literature subject groups.

Groups by subject and number of records found	
404 Specific	22
Buffers and Corridors	100
Cumulative Impacts	29
Development and Urban Impacts	103
Ecological Integrity Assessment	52
Erosion, Scour and Sedimentation	44
Mercury and Other Heavy Metals	49
Hydrology	47
Impoundments	92
Invasive Species	27
Mining Impacts	45
Powerlines and Pipelines	25
Regulation, Policy, Mitigation and Restoration	164
Roads	88
Roads and Wildlife	56
Silviculture	36
Stream Channel Geometry and Stability	115
Water Quality	127
Wetlands and Wildlife	65
Wetland Mitigation Web Sites	25

Literature on habitat alteration effects on wildlife is both voluminous and largely tangential to regulatory discussions. Still, for most species, responses to habitat change from secondary or direct impacts in the New England area are predictable based simply on an understanding of a particular species' life history and ecology.

Government documents and other "gray literature" are included in addition to peer-reviewed scientific literature, especially those containing comprehensive management recommendations for the New England region. Two such are the Metropolitan Conservation Alliance's "Forestry Habitat Management Guidelines for Vernal Pool Wildlife" (Calhoun and deMaynadier 2004) and the Wildlife Habitat Council's "A Guide to Managing Rights-of-Way for Wildlife Habitat" (Bonneau 2005).

As with the wildlife literature, literature is listed in which the relevance to 404 permitting may not be due primarily to impacts that arise from a permitted activity. Included are studies that describe methods to assess impacts (Brooks, Wardrop, and Cole 2006; Cohen et al. 2005), aspects of compensatory mitigation or ecosystem restoration (BenDor and Brozovic 2007; Brooks et al. 2005; Craig et al. 2008) and studies that may inform regulatory personnel about potential unintended or unforeseen consequences; some negative; such as the methylization of mercury in wetlands (Rumbold and Fink 2006; Watras et al. 2005); and some positive; such as nutrient uptake as an unintended benefit of stream restoration (Bukaveckas 2007).

The literature was reviewed for studies describing mitigation policy at the state and local level. This literature was found to be fairly limited and is generally aimed at the effectiveness of regulatory programs (Morgan and Roberts 2003). For this area of review, a subject group has been included containing web sites of state and local authorities where mitigation regulations and policies are described. Two web sites may prove particularly useful. One is the "Wetlands Information Resource Center" (National Center for Manufacturing Sciences 2010) located at *http://www.envcap.org/-statetools/swift/swift.html*. This web site contains summaries and links to each of the 50 states' web sites pertaining to wetland regulations and policy. The other is "Clean Water Act Section 404 Mitigation Guidance Directory" (National Oceanic and Atmospheric Administration Fisheries Service 2009) located at *http://www.mitigationactionplan.gov/links.html*.

Bibliographies for each of the 20 groups listed in Table 2 are included as separate appendices (Appendices A-T).

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Appendix C: Cumulative Impacts

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Appendix D: Development and Urban Impacts

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Appendix E: Ecological Integrity Assessment

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Appendix F: Erosion, Scour and Sedimentation

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Appendix I: Impoundments

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Appendix M: Regulation, Policy, Mitigation and Restoration

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Appendix N: Roads

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Appendix O: Roads and Wildlife

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Appendix R: Water Quality

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Appendix S: Wetlands and Wildlife

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REPORT DOCUMENTATION PAGE

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1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
July 2011	Final report	

4. TITLE AND SUBTITLE

A Bibliography of Selected Literature on Indirect Impacts Associated with Clean Water Act Section 404 Permits

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Timothy C. Wilder, William M. Ford, and Marie M. Perkins

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army Engineer Research and Development Center
Environmental Laboratory
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

8. PERFORMING ORGANIZATION REPORT NUMBER

ERDC/EL TR-11-6

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report summarizes a review of the scientific literature from the year 2000 to the present that characterizes indirect impacts associated with Clean Water Act Section 404 permits. Also of interest was literature from 2004 forward that addresses compensatory mitigation for impacts, particularly with respect to current policy.

Literature containing derivations of the search terms "Clean Water Act," "404," "temporary fill," "dredge and fill," "impact," "secondary impact," and "cumulative impact" in the title, keyword or abstract field(s) was selected. When these searches produced few results, the number of search terms was expanded. This series of searches returned in excess of 5,500 bibliographic records. Each record's abstract was then reviewed for relevance to the Corps of Engineer's 404 permitting program and assigned to at least one of 20 groups according to the focus of that particular study. A review for relevance and assignment to groups reduced the number of records to 1,252 (approximately 10% of which were assigned to more than one group).

15. SUBJECT TERMS

Bibliography
Clean Water Act
Compensatory mitigation
Indirect impact
Section 404 permits

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** *(include area code)*
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED		137	