TWENTY-YEAR TREND ANALYSIS OF OIL SPILLS IN EPA JURISDICTION

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ABSTRACT

Analyses of oil spillage into US Environmental Protection (EPA)-jurisdiction navigable waters since 1980 were conducted based on the newly-developed EPA Jurisdiction Oil Spill Database. Since 1980, nearly 304.3 million gallons of oil have spilled in 42,860 incidents of at least 50 gallons in inland waters under EPA jurisdiction for spill response. From 1980 to 1992, annual spillage averaged 13.2 million gallons – 20% more than the tanker Exxon Valdez spilled into in Alaska in 1989. However, spillage has decreased significantly in the last decade.

Numbers of *reported* spills have more than doubled since 1980. This increase is attributable to improved rates of reporting and recording of spills between 50 and 500 gallons. Concurrently, the spill rate for incidents *over* 500 gallons *decreased* significantly despite a 27% increase in US oil consumption since 1980. The decreased spillage attests to the effectiveness of spill prevention programs and measures. Analyses conducted on the spill data revealed notable trends by source, oil type, region, and spill size that may aid allocation of resources for prevention and response.

INTRODUCTION

Perceptions of increased oil spillage over the last decade or so are due in large part to greater media exposure and public interest after notorious spill events like the Exxon Valdez, the Bellingham, Washington, gasoline pipeline explosion and spill that tragically killed three young people, and other incidents, both in marine waters and in inland waterways, that have captured public attention due to their impacts. This increased public involvement and awareness about oil spills has had many positive effects, including the apparent increased reporting of smaller spills that had previously often been overlooked, and a greater commitment to demanding and supporting more regulation of potential spillers, greater penalties for offenders, and increased

spill response capabilities at both the federal and state levels. But, *perceptions* of spill rates are insufficient, and often misleading, in a more rigorous evaluation of the efficacy of spill prevention programs and determination of problem areas (*e.g.*, specific spill sources or regions with the highest spill rates) that may require greater attention by federal and state regulators. Thorough analyses of actual, accurate spill data are required to meet these important objectives.

METHODOLOGY

The EPA Jurisdiction Oil Spill Database was used to analyze oil spill trends for US inland navigable waterways for 1980 through 2000. (Data for 2001 and 2002 were not included in the analyses, as there were still a significant number of unverified data points.) The database includes oil spills of at least 50 gallons in which at least one gallon entered a navigable waterway or an adjoining shoreline, as defined in Table 1, within the EPA jurisdiction for spill response. (The Great Lakes, being in US Coast Guard response jurisdiction, are not included.) Oil types included in the database and the analyses conducted in this study are listed in Table 2. The spills were also divided into subgroups according to oil type, EPA Region, state, source type, and spill cause to provide information on problem areas to be addressed for future prevention efforts. The data were also analyzed by spill size. Cumulative probability distribution functions of spill volume and spill size were developed. Probability distribution functions show the percentile of spill sizes, *i.e.,* the spill size at which that percentage of spills is smaller and only the remaining proportion is larger (*e.g.,* the 75^{th} percentile spill size is that spill volume for which 75% of spills are smaller and 25% of spills are larger.) The probability distribution function was used to determine the probability of different spill size scenarios in EPA jurisdiction. [Spill data from the years 2001 and 2002 were determined to be "preliminary" and likely overestimates of spill volume due to the presence of a few very large spills reported to authorities but not verified. These spills are likely to be reports of spill exercises or spill drills that were not properly coded as such. Future analyses will have verified data for these years.]

RESULTS

Figure 1 shows the annual amount of oil spilled as well as the number of spills of 50 gallons or more. There is an apparent increase in annual number of spills of 50 gallons or more. This increase is likely due to greater *reporting* of spills rather than an actual increase in the incidence of spills. When the annual number of spills of 500 gallons or more are analyzed, a clear reduction in the spill rate is seen (Figure 2). The average annual volume of oil spilled has decreased from 14.6 million gallons per year in the early 1980s to 8.2 million gallons per year since 1995 – a reduction of 44% (Figure 3). The reduction in spillage is even more remarkable when contrasted to the increase in oil consumption in the US (Figure 4). The annual numbers of oil spills of 500 gallons or more per million barrels of oil consumption has decreased, as shown in Figure 5. Annual *numbers* of spills of 500 gallons or more rather than total annual spill volumes were used in rate analysis to remove the confounding factor of spill volumes from very large spills that overwhelm spill data in individual years. The rationalization for this was that any particular spill could result in a larger release but for certain chance occurrences in each spill event. Spill *numbers* are a more accurate reflection of the efficacy of prevention measures rather than spill volumes. Spill volumes are often a greater indicator of the efficacy of salvage or source control measures (*e.g.,* being able to detect and reduce the size of a release after the oil has starting leaking) than of prevention measures. The annual number of oil spills of 500 gallons or more *per million barrels of oil consumed* has decreased by 50% in the last 20 years.

Analysis of specific characteristics of the spills revealed a number of trends. Oil spills by source type are shown in Table 3. About 80% of the volume of oil spilled came from pipelines and other facilities. Crude oil accounted for the greatest volume spilled, while light fuel spills, particularly diesel and No. 2 fuel oil, accounted for the greatest number of spills (Table 4). Nearly 40% of spills did not have any known or reported cause (Table 5). Of those spills with causes assigned by authorities, the largest percentage of both spill number (23.7%) and spill volume (42.3%)

were due to structural failure (*e.g.,* pipeline corrosion). Operational error accounted for 21.5% of spills, though these spills tended to be considerably smaller than those due to structural failure. Explosions and fires, though rare, caused the largest average spill volumes. EPA Region 6 had the greatest volume and number of spills, as well as the largest average spill volume (Table 6). Texas had the largest total spill volume of nearly 71 million gallons, followed by California with 22.5 million gallons (Table 7). Taken on a square-mile basis, however, there were more spills per square mile and gallons per square mile in the District of Columbia and the smaller states of Massachusetts, Delaware, Maine, Pennsylvania, and Connecticut (Table 8). Across the US, an average of 80 gallons of oil spilled per square mile during 1980 through 2002.

Figure 6 shows the cumulative number and volume of oil spilled in different spill sizes. About 95% of spills of at least 50 gallons are smaller than 10,500 gallons. Figure 7 is the probability distribution function of spill size. Table 9 shows the various percentile spills and worst-case discharge scenarios for EPA response jurisdictions. These analyses only included spills of at least 50 gallons. There are many spills smaller than this spill volume that occur on a frequent basis, though the reporting of these spills is inconsistent due to variations in local and state laws, as well as a tendency for individuals and industry to avoid reporting these spills due to ignorance of regulations, negligence, or fear of repercussions. A study conducted by Environmental Research Consulting on vessel spills in US marine waters on spills of all sizes down to one gallon shows that about 99% of spills are under 50 gallons, though these spills only add up to about 20% of the total volume spilled (Etkin 2001). An analogous situation exists with spills in EPA jurisdiction waters.

DISCUSSION

Overall, oil spillage is down in US inland waterways under EPA jurisdiction for spill response, which is a reflection of the success of spill prevention programs and regulations, as well as a concern by industry and other potential spillers that the tremendous costs and other consequences

of oil spills are considerable. The rate of spill reporting for smaller spills has increased dramatically, attesting to the success of public awareness campaigns and enforcement of federal and state regulations. But, there is still an average of 8 million gallons of oil spilling annually in EPA waters. Areas of greatest concern continue to be those with oil production and storage, especially in EPA Region 6. The District of Columbia and other densely-populated northeast states have a large number and volume of spillage on a per-area basis. Different spills present greater or lesser potential impacts (see Etkin, 2004). Spills of heavier oils cause greater long-term damage from both environmental and socioeconomic perspectives due to their persistence. But even light fuel oils, such as diesel, can cause impacts when the oil gets into groundwater or water supply systems. Clearly, despite obvious success in spill prevention, there remains a great deal of work to do in the prevention and reduction of oil spillage. One area of focus should be inspection of oil storage and transport facilities, as most spills of known cause are attributed to structural failure of pipelines, storage tanks, and facility structures.

ACKNOWLEDGEMENTS

This work was conducted under a subcontract to Abt Associates, Inc., US Environmental Protection Agency Contract No. 68-W-01-039. The EPA Jurisdiction Oil Spill Database was custom developed from the proprietary databases of Environmental Research Consulting for use by the EPA Oil Center and EPA Regional Offices.

BIOGRAPHY

Dagmar Schmidt Etkin received her B.A. in Biology from University of Rochester, and her A.M. and Ph.D. in Biology (specializing in population biology, ecology, and statistical analysis) from Harvard University. She has analyzed and modeled oil spill data and impacts for 15 years.

REFERENCES

Etkin, D.S. 2001. Analysis of oil spill trends in the US and worldwide. *Proceedings of the 2001 International Oil Spill Conference:* pp. 1,291-1,300.

Etkin, D.S. 2004. Modeling oil spill response and damage costs. *Proceedings of the Fifth Biennial Freshwater Spills Symposium*: (current volume).

US Department of Energy. 2001*a*. *International Petroleum Monthly.* Energy Information Administration, June 2001.

US Department of Energy. 2001*b*. *Petroleum Supply Monthly.* Energy Information Administration. June 2001.

US Department of Energy. 2001*c*. *State Energy Data Report 1999: Consumption Estimates.* Energy Information Administration, May 2001.

US Department of Energy. 2002. *Petroleum Marketing Monthly.* Energy Information Administration. April 2002.

Table 1: Terms Used in Development of EPA Jurisdiction Oil Spill Database
Navigable Waters[1]: US waters *and adjoining shorelines*, including: i.) All waters currently used, used in the past, or may be used in interstate or foreign commerce, including all waters subject tidal ebb and flow; ii.) All interstate waters, including interstate wetlands; iii.) All other waters, such as intrastate lakes, rivers, and streams (including intermittent streams), mudflats, sandflats, wetlands, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce, including any such waters: (A) that are or could be used by interstate or foreign travelers for recreational or other purposes; or (B) from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or (C) that are or could be used for industrial purposes by industries in interstate commerce. iv.) Tributaries of waters identified in (i) to (iii); and v.) Wetlands adjacent to waters identified in (i) to (iv).
Spill: Oil discharge by spilling, leaking, pumping, pouring, emitting, emptying, or dumping, *excluding* discharges in compliance with permits under Clean Water Act section 402, River and Harbor Act section 13, or MARPOL.
Facility: Any mobile or fixed, onshore or offshore building, structure, installation, equipment, pipe, or pipeline (*other than a vessel)* used in oil well drilling operations, production, refining, storage, gathering, processing, transfer, distribution, and waste treatment, or in which oil is used.
Other Vessel: Any vessel or water carrier that carries oil as fuel and for other operational purposes (machine oil, *etc.*) but does *not* carry oil as cargo.
[1]Only waters that were within EPA jurisdiction for oil spill response based on Memoranda of Understanding with US Coast Guard and Area Contingency Plans were included.

Table 2: Oil Types Included in EPA Jurisdiction Oil Spill Database By Category
Crude: crude (unspecified); medium crude
Heavy Crude: heavy crude
Light Crude: light crude
Light Oil: absorption oil; light cycle oil; hydraulic oil; light oil; cutting oil; decant oil; catalytic feedstock; emulsion oil; spray oil; petroleum distillate; carbolic oil; gas oil; lean oil; clarified oil; produced oil; process oil; petrolatum
Light Fuel: No. 2 fuel oil; drill mud oil; naphtha
Volatile Distillate: **g**asoline; No. 1 fuel oil; crude condensate
Intermediate Fuel: No. 3 fuel oil; No. 4 fuel oil; transmix
Heavy Oil: heavy fuel; No. 6 fuel oil; residual oil; heavy oil
Tar: tar; asphalt; creosote; wash oil; tack oil
Wax: wax; paraffin; carnauba wax
Waste Oil: waste oil; oily waste
Other Oil: neatsfoot oil; dusting oil; penetrating oil; synthetic oil; road oil; resin oil; hot oil
Non-Edible Vegetable Oil: tung oil; tanner oil; tall oil; pine oil; linseed oil; castor oil
Mineral Oil: thermal oil; quench oil; mineral oil; insulating oil; heat transfer oil; transmission oil
Lube Oil: spindle oil; lubricating oil; gear oil; machine oil; compressor oil; crankcase oil; cycle oil
Edible Oil: vegetable oil; soybean oil; seal oil; safflower oil; peanut oil; palm oil; fish oil; croton oil; cottonseed oil; corn oil; coconut oil; canola oil
Animal Fat: tallow; sperm oil; lard; animal fat

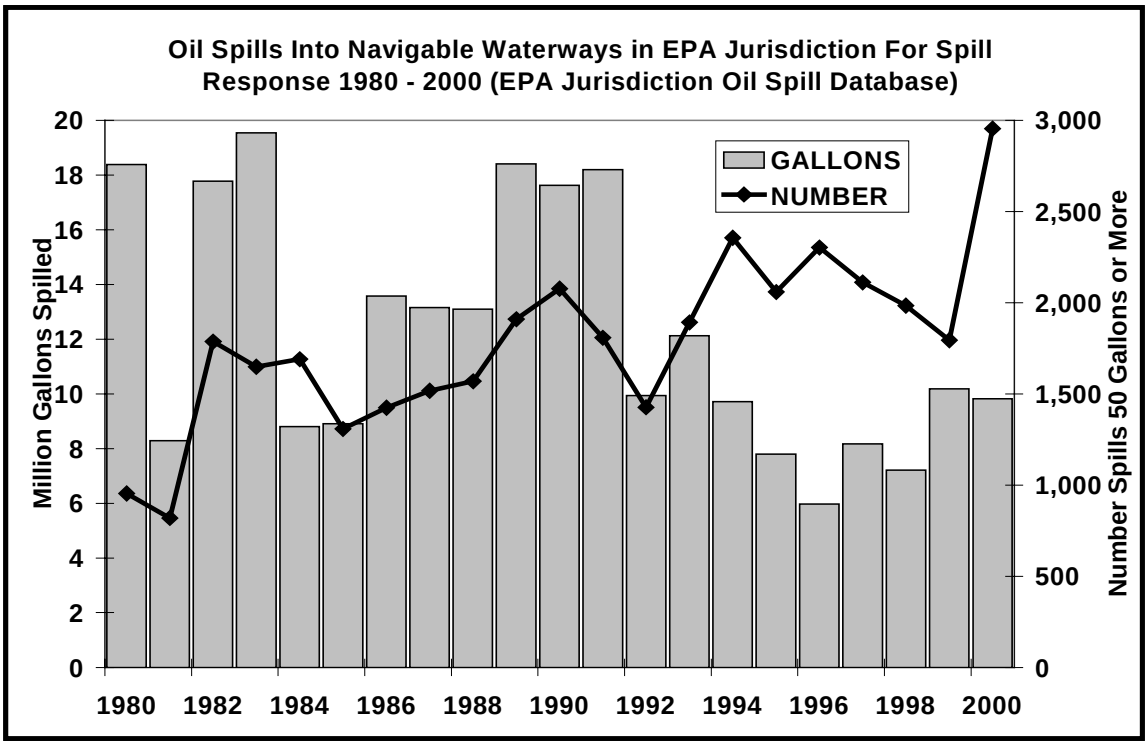

Figure 1: Annual oil spillage into navigable waters in EPA jurisdiction for spill response shows an increase in annual number of spills of 50 gallons or more. This increase is likely due to greater *reporting* of spills rather than an actual increase in the incidence of spills.

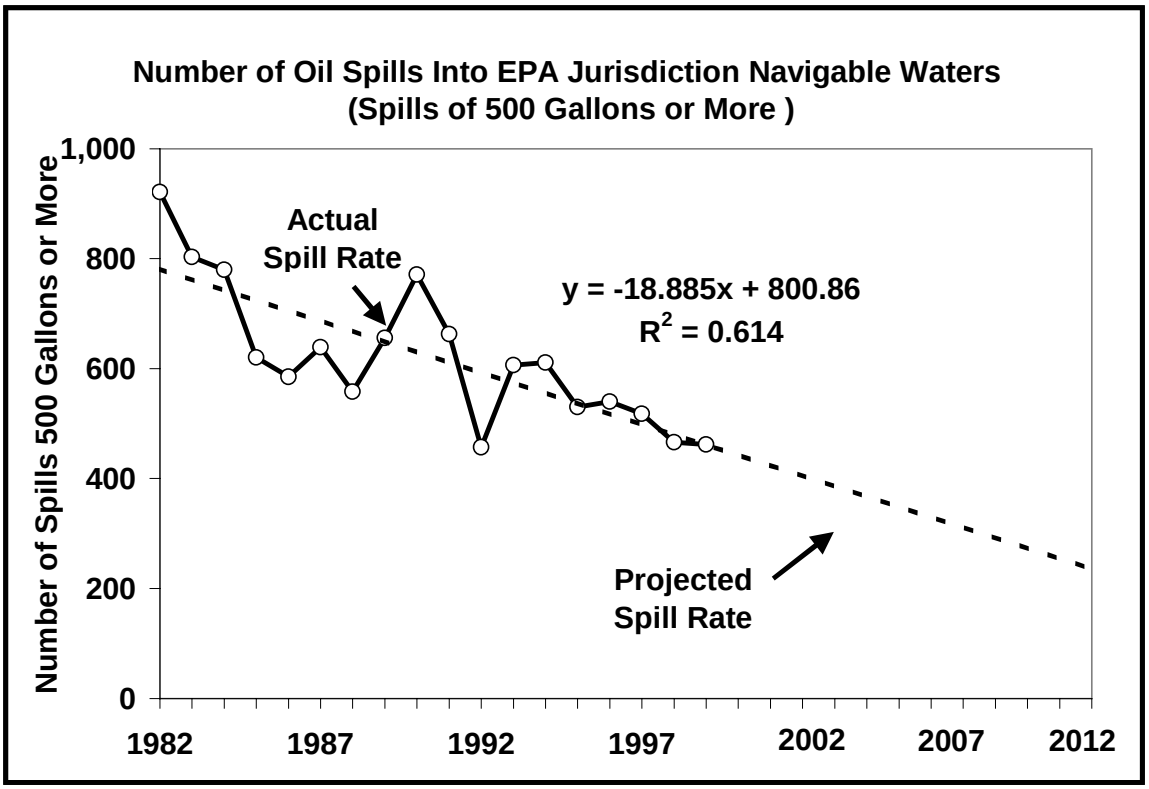

Figure 2: The annual number of spills of 500 gallons or more shows a significant decrease. The spill rate was projected into the future (to 2012) by extending the best-fit regression slope of the actual spill rate.

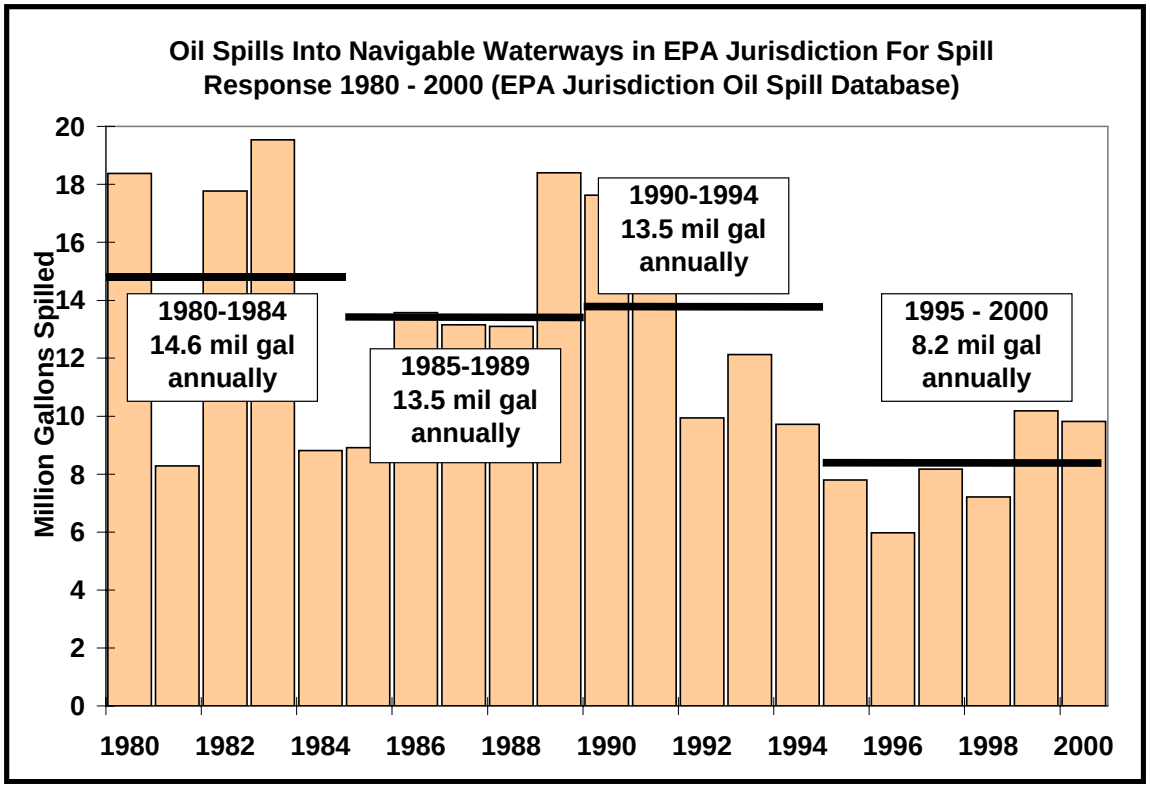

Figure 3: The average annual volume of oil spilled into navigable waters in EPA jurisdiction for response has decreased by 44% since the early 1980s.

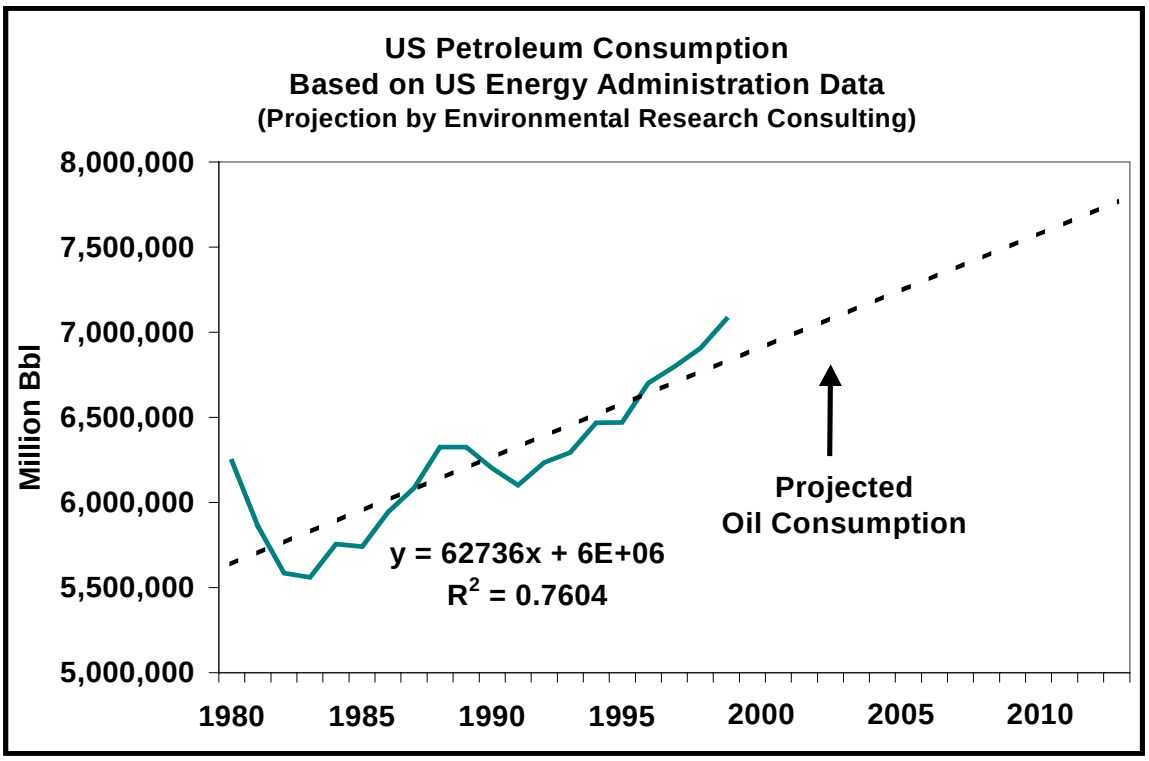

Figure 4: US annual petroleum consumption based on US Dept of Energy (2001*a,b,c;* 2002). Projection for future consumption based on best-fit regression slope.

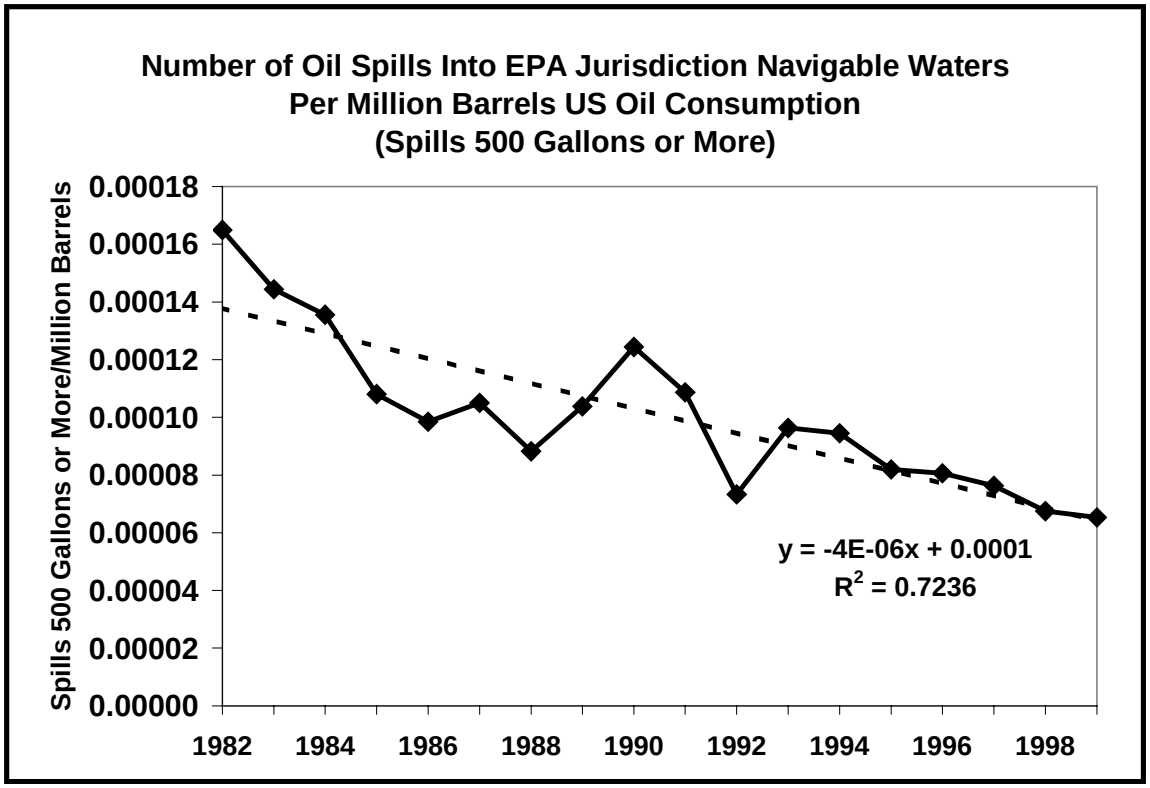

Figure 5: The number of oil spills of 500 gallons or more *per million barrels of oil consumed* has decreased by 50% in the last 20 years.

Table 3: Oil Spills into Navigable Waters in EPA Jurisdiction[1,2] 1980 - 2002				
Source Type	**Spill Number** ***(≥ 50 gallons)***	**% Total Number**	**Volume Spilled** ***(spills ≥ 50 gallons)***	**% Total Amount**
Pipeline	8,351	19.48%	130,348,268	42.83%
Facility[3]	16,963	39.58%	112,584,233	37.00%
Storage tank[3]	3,216	7.50%	40,200,829	13.21%
Other vehicle	5,173	12.07%	4,382,725	1.44%
Railroad	1,098	2.56%	3,502,533	1.15%
Tank barge	397	0.93%	3,417,405	1.12%
Tank truck	1,930	4.50%	2,939,133	0.97%
Production well	147	0.34%	2,661,558	0.87%
Unknown	888	2.07%	1,399,771	0.46%
Other vessel	1,172	2.73%	1,290,529	0.42%
Residence[3]	2,488	5.80%	1,165,060	0.38%
Transformer	517	1.21%	189,887	0.06%
Aircraft	383	0.89%	186,307	0.06%
Drums	133	0.31%	32,068	0.01%
Tank ship	3	0.01%	4,300	0.00%
Natural seep	1	0.00%	4,200	0.00%
TOTAL	**42,860**	**100%**	**304,308,806**	**100%**

[1]Based on US EPA Jurisdiction Oil Spill Database developed by Environmental Research Consulting Database. [2]Navigable waters and adjoining shorelines as defined in Table 1. [3]There may be some overlap between these categories as spill sources are not always accurately described in original spill reports or state and federal records.

Table 4: Oil Spills in US EPA Jurisdiction Navigational Waters[1,2] By Oil Type 1980 - 2002				
Oil Type[3]	**Spill Number** ***(≥ 50 gallons)***	**% Total Number**	**Volume** ***(spills ≥ 50 gallons)***	**% Total Amount**
Crude	10,995	25.65%	129,756,617	42.64%
Volatile Distillate	6,805	15.88%	67,980,494	22.34%
Light Fuel	15,627	36.46%	50,154,031	16.48%
Heavy Oil	1,183	2.76%	15,447,152	5.08%
Tar	673	1.57%	13,790,455	4.53%
Other Oils	471	1.10%	6,450,273	2.12%
Light Oil	1,272	2.97%	5,581,290	1.83%
Unknown Oil	1,380	3.22%	4,859,911	1.60%
Lube Oil	1,400	3.27%	3,529,183	1.16%
Waste Oil	1,029	2.40%	2,684,610	0.88%
Mineral Oil	1,364	3.18%	1,469,374	0.48%
Intermediate Fuel Oil	335	0.78%	1,329,707	0.44%
Edible Oil	193	0.45%	815,800	0.27%
Animal Fat	58	0.14%	327,318	0.11%
Non-Edible Vegetable Oil	51	0.12%	76,900	0.03%
Wax	24	0.06%	55,817	0.02%

[1]Based on US EPA Jurisdiction Oil Spill Database developed by Environmental Research Consulting Database. [2]Navigable waters and adjoining shorelines as defined in Table 1. [3]Oil type categories defined in Table 2.

Table 5: Causes of Oil Spills in EPA Jurisdiction Navigable Waters[1,2] 1980 - 2002					
Cause Type	**Number Spills ≥ *50 gallons***	**% Total Number**	**Volume** *(spills ≥ 50 gal)*	**% Total Amount**	**Average Size *(gallons)***
Structural Failure	6,149	14.35%	102,512,279	33.69%	16,671
Unknown/Unreported	16,906	39.44%	62,185,219	20.43%	3,678
Equipment Malfunction	4,879	11.38%	39,636,683	13.03%	8,124
Mechanical Damage	2,181	5.09%	30,203,604	9.93%	13,849
Operational Error	5,580	13.02%	22,802,734	7.49%	4,087
Natural Phenomenon	736	1.72%	15,597,764	5.13%	21,193
Fire/Explosion	147	0.34%	14,915,974	4.90%	101,469
Vehicular Accident	2,955	6.89%	4,329,289	1.42%	1,465
Other Cause	1,708	3.99%	3,595,019	1.18%	2,105
Vandalism	532	1.24%	3,426,670	1.13%	6,441
Derailment	185	0.43%	2,072,698	0.68%	11,204
Vessel Accident	135	0.31%	1,701,093	0.56%	12,601
Dumping	529	1.23%	1,143,690	0.38%	2,162
Structural Defect	207	0.48%	165,723	0.05%	801
Aircraft Accident	30	0.07%	16,168	0.01%	539
Natural Seep	1	0.00%	4,200	0.00%	4,200
TOTAL	**42,860**	**100%**	**304,308,806**	**100%**	**7,100**

[1]Based on US EPA Jurisdiction Oil Spill Database developed by Environmental Research Consulting Database. [2]Navigable waters and adjoining shorelines as defined in Table 1.

Table 6: Oil Spillage in Navigable Waters in EPA Jurisdiction[1,2] By EPA Region 1980 - 2002					
EPA Region	**Number Spills ≥ *50 gallons***	**% Total Number**	**Volume** *(spills ≥ 50 gal)*	**% Total Amount**	**Average Size *(gallons)***
1	7,869	18.4%	8,493,311	2.8%	1,079
2	1,704	4.0%	12,078,503	4.0%	7,088
3	4,452	10.4%	27,626,311	9.1%	6,205
4	4,321	10.1%	27,485,530	9.0%	6,361
5	7,227	16.9%	47,237,656	15.5%	6,536
6	8,676	20.2%	107,292,008	35.3%	12,367
7	1,889	4.4%	20,571,180	6.8%	10,890
8	2,797	6.5%	22,283,354	7.3%	7,967
9	1,949	4.5%	24,130,462	7.9%	12,381
10	1,976	4.6%	7,110,617	2.3%	3,598
TOTAL	**42,860**	**100.0%**	**304,308,932**	**100.0%**	**7,100**

[1]Based on US EPA Jurisdiction Oil Spill Database developed by Environmental Research Consulting Database.
[2]Navigable waters and adjoining shorelines as defined in Table 1.

Table 7: Oil Spillage in Navigable Waters in EPA Jurisdiction[1,2] By State 1980 – 2002					
STATE	**Spill Number** ***≥ 50 gallons***	**% Total Number**	**Volume** *(spills ≥ 50 gal)*	**% Total Amount**	**Average Size** ***(gallons)***
AK	1,304	3.04%	3,412,141	1.12%	2,617
AL	799	1.86%	1,384,606	0.46%	1,733
AR	913	2.13%	2,840,451	0.93%	3,111
AZ	146	0.34%	1,284,562	0.42%	8,798
CA	1,714	4.00%	22,533,932	7.40%	13,147
CO	370	0.86%	3,377,430	1.11%	9,128
CT	634	1.48%	680,882	0.22%	1,074
DC	84	0.20%	227,277	0.07%	2,706
DE	61	0.14%	1,378,734	0.45%	22,602
FL	476	1.11%	2,918,616	0.96%	6,132
GA	450	1.05%	1,258,268	0.41%	2,796
HI	37	0.09%	67,443	0.02%	1,823
IA	222	0.52%	3,352,694	1.10%	15,102
ID	82	0.19%	907,087	0.30%	11,062
IL	1,498	3.50%	11,690,025	3.84%	7,804
IN	552	1.29%	6,866,241	2.26%	12,439
KS	767	1.79%	7,487,220	2.46%	9,762
KY	876	2.04%	5,862,414	1.93%	6,692
LA	1,596	3.72%	8,934,673	2.94%	5,598
MA	2,775	6.47%	4,234,393	1.39%	1,526
MD	719	1.68%	3,556,217	1.17%	4,946
ME	4,143	9.67%	3,133,717	1.03%	756
MI	531	1.24%	5,639,199	1.85%	10,620
MN	321	0.75%	5,815,578	1.91%	18,117
MO	731	1.71%	8,361,449	2.75%	11,438
MS	489	1.14%	3,839,084	1.26%	7,851
MT	163	0.38%	2,825,039	0.93%	17,332
NC	459	1.07%	3,040,188	1.00%	6,624
ND	127	0.30%	3,679,765	1.21%	28,975
NE	169	0.39%	1,369,817	0.45%	8,105
NH	132	0.31%	192,091	0.06%	1,455
NJ	570	1.33%	1,315,146	0.43%	2,307
NM	144	0.34%	3,912,490	1.29%	27,170
NV	52	0.12%	244,525	0.08%	4,702
NY	1,030	2.40%	10,420,760	3.42%	10,117
OH	1,584	3.70%	11,565,181	3.80%	7,301
OK	1,976	4.61%	21,032,530	6.91%	10,644
OR	248	0.58%	375,185	0.12%	1,513
PA	1,205	2.81%	14,579,081	4.79%	12,099
PR	101	0.24%	340,247	0.11%	3,369

Table 7: Oil Spillage in Navigable Waters in EPA Jurisdiction[1,2] By State 1980 – 2002 *(continued)*					
STATE	**Spill Number** ***≥ 50 gallons***	**% Total Number**	**Volume** *(spills ≥ 50 gal)*	**% Total Amount**	**Average Size** ***(gallons)***
RI	107	0.25%	199,831	0.07%	1,868
SC	242	0.56%	5,524,521	1.82%	22,829
SD	1,040	2.43%	1,930,552	0.63%	1,856
TN	530	1.24%	3,657,833	1.20%	6,902
TX	4,047	9.44%	70,571,864	23.19%	17,438
UT	507	1.18%	2,257,299	0.74%	4,452
VA	1,001	2.34%	6,217,763	2.04%	6,212
VI	3	0.01%	2,350	0.00%	783
VT	78	0.18%	52,397	0.02%	672
WA	342	0.80%	2,416,204	0.79%	7,065
WI	2,741	6.40%	5,661,432	1.86%	2,065
WV	1,382	3.22%	1,667,239	0.55%	1,206
WY	590	1.38%	8,213,269	2.70%	13,921
TOTAL	**42,860**	**100.00%**	**304,308,932**	**100.00%**	**7,100**

[1]Based on US EPA Jurisdiction Oil Spill Database developed by Environmental Research Consulting Database.
[2]Navigable waters and adjoining shorelines as defined in Table 1.

Table 8: Oil Spills in Navigable Waters in EPA Jurisdiction Per Square Mile Area[1] 1980 -2002								
State	**Number Per Sq. Mi**	**Gallons Per Sq. Mi**	**State**	**Number Per Sq. Mi**	**Gallons Per Sq. Mi**	**State**	**Number Per Sq. Mi**	**Gallons Per Sq. Mi**
AK	0.002	5	**LA**	0.031	172	**OK**	0.028	301
AL	0.015	26	**MA**	0.263	401	**OR**	0.003	4
AR	0.017	53	**MD**	0.058	287	**PA**	0.026	317
AZ	0.001	11	**ME**	0.117	89	**PR**	0.019	64
CA	0.010	138	**MI**	0.005	58	**RI**	0.069	129
CO	0.004	32	**MN**	0.004	67	**SC**	0.008	173
CT	0.114	123	**MO**	0.010	120	**SD**	0.013	25
DC	1.235	3,342	**MS**	0.010	79	**TN**	0.013	87
DE	0.025	554	**MT**	0.001	19	**TX**	0.015	263
FL	0.007	44	**NC**	0.009	56	**UT**	0.006	27
GA	0.008	21	**ND**	0.002	52	**VA**	0.023	145
HI	0.003	6	**NE**	0.002	18	**VI**	0.018	14
IA	0.004	60	**NH**	0.014	21	**VT**	0.008	5
ID	0.001	11	**NJ**	0.065	151	**WA**	0.005	34
IL	0.026	202	**NM**	0.001	32	**WI**	0.042	86
IN	0.015	189	**NV**	0.000	2	**WV**	0.057	69
KS	0.009	91	**NY**	0.019	191	**WY**	0.006	84
KY	0.022	145	**OH**	0.035	258	**ALL**	**0.0113**	**80**

[1]Total land and water area.

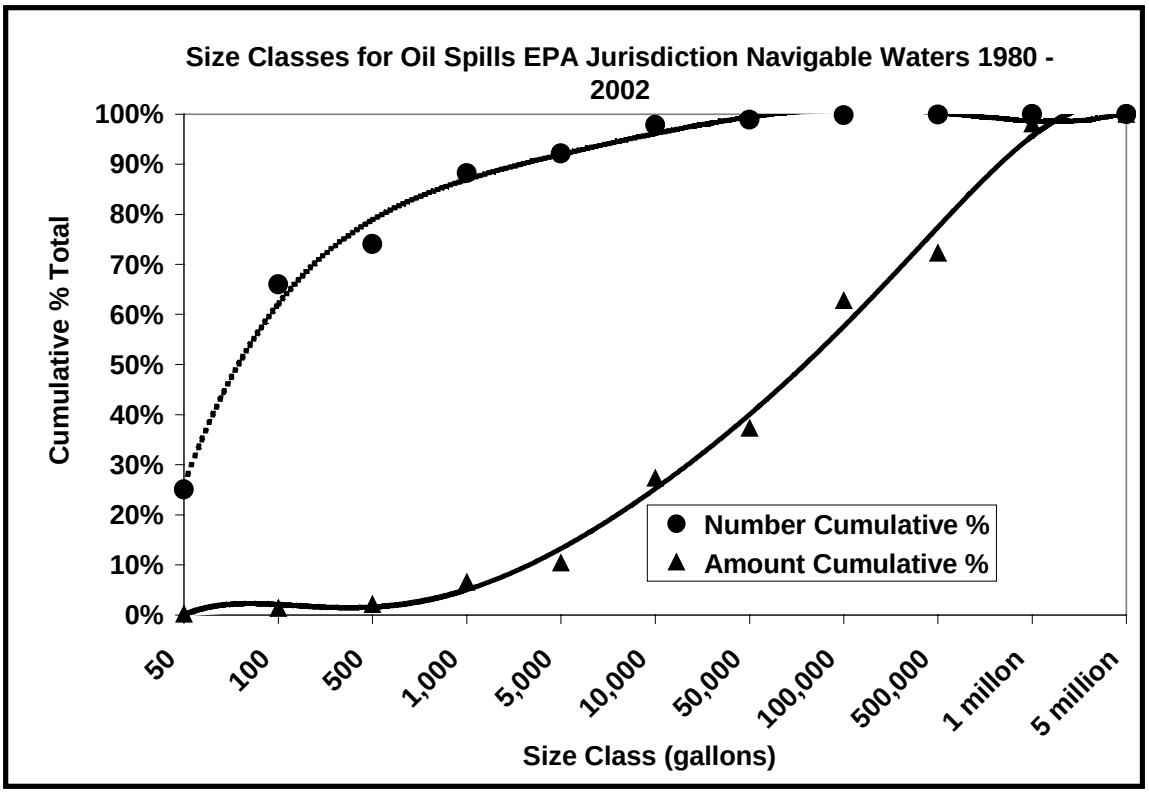

Figure 6: Cumulative frequency of spill numbers by spill size shown on continuous size scale (not by size class). The smallest spills quickly make up the vast majority of the total number of spills. Only a few spills are larger that 1 million gallons.

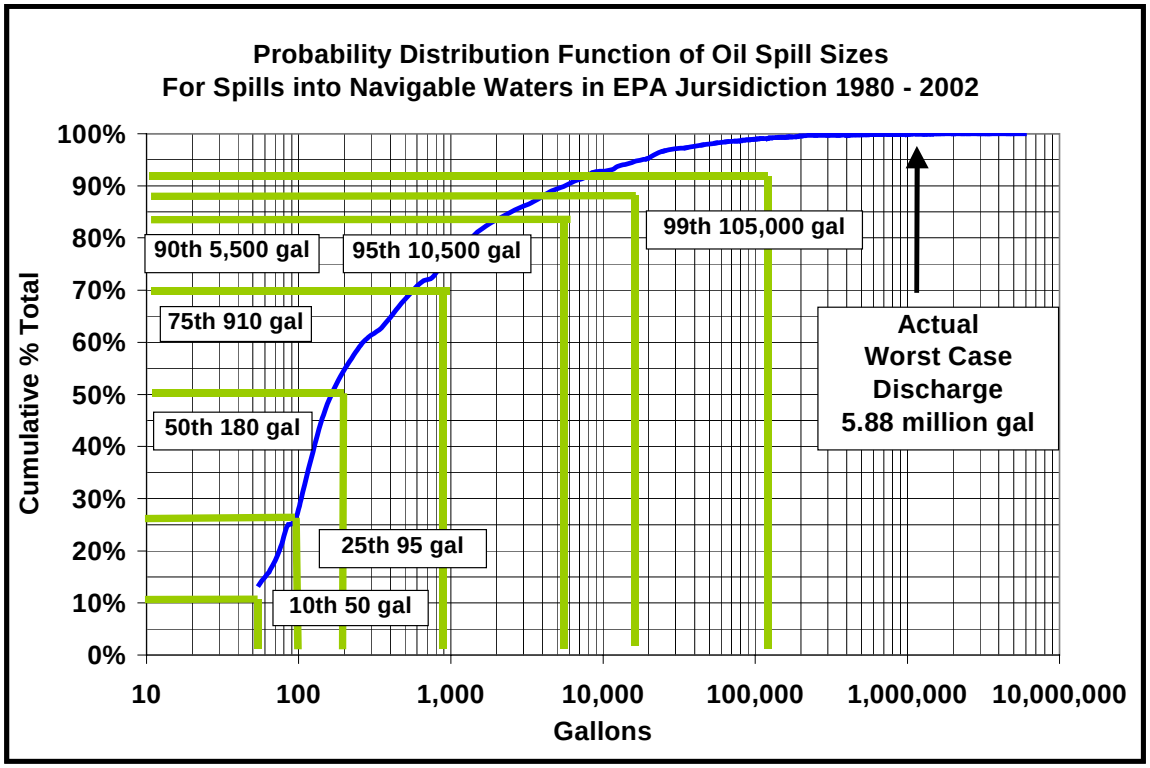

Figure 7: Probability distribution function of EPA jurisdiction navigable water oil spill sizes shows the percentile of spill sizes, *i.e.*, the spill size at which that percentage of spills are smaller and only the remaining proportion are larger. (Note *logarithmic* X scale.)

Table 9: Oil Spill Scenarios for EPA Jurisdiction Navigable Waters[1,2,3]		
Spill Scenario[4]	**Definition**	**Quantity**
10th percentile[5]	10% incidents *of all incidents*[5]	50 gal
25th percentile	25% incidents *smaller,* 75% *larger*	95 gal
50th percentile	50% incidents *smaller,* 50% *larger*	180 gal
75th percentile	75% incidents *smaller,* 25% *larger*	910 gal
90th percentile	90% incidents *smaller,* 10% *larger*	5,500 gal
95th percentile	95% incidents *smaller,* 5% *larger*	10,500 gal
99th percentile	99% incidents *smaller,* 1% *larger*	105,000 gal
Actual WCD[6]	Historical worst case discharge based on 1980 – 2002 data	5.88 million gal
Potential WCD[6]	Complete discharge of largest storage tank/pipeline/tankship that might discharge into non-marine navigable waters	14.5 million gal[7]

[1]Based on US EPA Jurisdiction Oil Spill Database by Environmental Research Consulting Database. [2]Navigable waters and adjoining shorelines as defined in Table 1. [3]Facilities as defined in Table 1. [4]For reportable spills of *at least 50 gallons*. [5]About 10% of spills are 50 gallons. [6]WCD = worst case discharge. [7]Based on size of largest product tankship likely to transit EPA jurisdiction waters.