levels for contaminants in sediment having potential population-level effects to fish, wildlife and other ecological receptors were derived for the contaminated prey ingestion, incidental sediment ingestion and/or dermal contact exposure pathways and correspond to an acceptable exposure level to which sensitive environmental populations (including sensitive species/taxa) may be chronically exposed to without adverse population-level effects (such as reduction in number of individuals or elimination of a local population). Exposure parameters for the contaminated prey ingestion, incidental sediment ingestion and/or dermal contact exposure pathways have been described in the Baseline Ecological Risk Assessment. If a cleanup value described above is below background values, then a background value was used as appropriate for the sediment cleanup level.

As part of pre-design, additional background characterization will be conducted to extend the current limited background dataset, verify background data and statistical analysis. Background sediment samples would be analyzed for dioxin/furans, including 2,3,7,8-TCDD, Coplanar PCBs, pesticides, PCBs, VOCs, SVOCs, and metals. If necessary, sediment cleanup levels which are based on background levels will be adjusted using these data and documented in subsequent decision documents. Sediment cleanup levels based on background may result in elevated risk to receptors, since cleanup levels cannot be established below background to avoid potential recontamination.

Tables L-6 through L-9 summarize the cleanup levels for contaminants identified in Allendale and Lyman Mill Ponds Sediment.

These sediment cleanup levels attain EPA's risk management goal for remedial actions and have been determined by EPA to be protective. These sediment cleanup levels must be met at the completion of the remedial action at the points of compliance throughout the entire area of Lyman Mill Pond and Allendale Pond by confirmatory sampling using an area-weighted average contaminant concentrations approach in each Pond. This confirmatory sampling will determine the extent of a thin-layer cover, if such cover is required in these Ponds, to meet sediment RAOs. Specific criteria to be used to determine the need and extent of such thin-layer cover will be determined as part of the design and construction plans.

To monitor progress of remediation and to determine when fish are safe to eat following attainment of the sediment cleanup levels, fish target tissue concentrations for bioaccumalative contaminants were also developed using sediment cleanup levels and site-specific BSAFs. Table L-10 presents calculated fish target tissue concentrations for the Allendale and Lyman Mill Ponds.

Sampling and analysis of fish tissue will be included in the long-term monitoring program. Fish tissue will be collected and analyzed from each individual pond on an annual or biannual basis, with fish samples number for each species and pond to be determined based on the fish sampling conducted to-date and an appropriate statistical analysis. The long-term monitoring program is expected to target the same species that have been sampled previously: largemouth bass, American eel, and white sucker. In the event that the fish community changed substantially, (as could be the case where fish ladders are constructed or dams are removed at some point in the future), then the expected new species should be monitored. Fish tissue analytical parameters

or elimination of a local population). Exposure parameters for the contaminated prey ingestion, incidental soil ingestion and dermal contact exposure pathways have been described in the Baseline Ecological Risk Assessment. If a cleanup value described above is below background values, then a background value was used as appropriate for the soil cleanup level.

Sediment cleanup levels for Lyman Mill Pond apply to Lyman Mill Stream Sediment and Floodplain Soil. Tables L-16 through L-18 summarize the soil cleanup levels for contaminants identified in Lyman Mill Stream Sediment and Floodplain Soil.

These cleanup levels in soils and sediment are consistent with ARARs for soil, attain EPA's risk management goals for remedial actions, and have been determined by EPA to be protective. These soil/sediment cleanup levels must be met at the completion of the remedial action at the point of compliance (throughout) in the Lyman Mill Stream Sediment and Floodplain Soil. Confirmatory sampling will be performed in the excavated areas at the end of the construction to confirm that the criteria for excavation, such as site-specific dioxin cleanup levels, and RIDEM residential direct exposure criteria, have been met, in addition to excavation of areas subject to erosion by confirming the delineated excavation footprint. For residential-use properties, incremental composite sampling of floodplain soil on approximately 20 properties will be used to evaluate areas requiring excavation. Precautionary measures to prevent exposure, such as fencing or spreading a cover (e.g., mulch or clean soil) may be taken on residential-use properties in the interim.

7. Site-wide Remedy Features

Site-wide Mitigation

Mitigation must be done to meet regulatory wetlands and floodplain requirements including but not limited to the following:

Out-of-kind mitigation for the lost habitat would be provided adjacent to the river, most likely along the western shore of Lyman Mill Pond and developing a permanent buffer zone. Several candidate locations along the western edge of Lyman Mill Pond include the mouth of Assapumpset Stream and former wetland situated southwest of the river channel remnant in the Oxbow Area, and a couple of other potential restoration opportunities along the eastern shoreline of Lyman Mill Pond

In addition, historical filling activities near the southwestern corner of the Oxbow Area and the confluence of Assapumpset Stream with the river provide opportunities for wetland restoration. The fill material would be removed, the original soil material tested for contamination (and further excavated as necessary), the land surface graded to re-establish proper wetland hydrology and then replanted to develop emergent marsh, scrub/shrub or palustrine forest habitat to be specified in the mitigation plan. Control of invasive species would also be required.

It is assumed that all work will be performed in an upstream to downstream direction to prevent re-contamination of areas previously remediated and that all remediation work will be carried concurrently in the Allendale Reach before proceeding to the Lyman Mill Reach.

Table L-6. Allendale Pond Sediment and Sediment Associated Fish Consumption for a Resident Living Along the River

Carcinogenic Contaminant	Cancer Classification	Sediment Cleanup Level[1] (mg/Kg)	Basis	RME Residual Cancer Risk	
Benzo(a)pyrene	B2	1.4	Background[a]	4.E-06	A
Dibenz(a,h)anthracene	B2	0.97	Background[a]	2.E-06	A
Dieldrin	B2	0.0026	Background[a]	2.E-06	B
Technical Chlordane	B2	0.4	Background[b]	8.E-06	B
Aroclor 1254	B2	0.031	Background[ac]	8.E-06	B
Aroclor 1268	B2	0.023	Background[ac]	2.E-06	B
Arsenic	A	3.9	Background[a]	1.E-06	A
2,3,7,8-Tetrachlorodibenzo-p-dioxin[2]	B2	0.000015	Background[a]	3.E-05	C
Coplanar PCBs (TEQ)[3]	B2	0.000025	Background[a]	--	D
			Sum of Carcinogenic Risk	**5.E-05**	

Non-Carcinogenic Contaminant	Target Endpoint	Sediment Cleanup Level (mg/Kg)	Basis	RME Residual Hazard Index	
Benzo(a)pyrene	Kidney	1.4	Background[a]	0.0001	A
Dibenz(a,h)anthracene	Kidney	0.97	Background[a]	0.00008	A
Dieldrin	Liver	0.0026	Background[a]	0.007	B
Technical Chlordane	Liver	0.4	Background[b]	0.1	B
Aroclor 1254	Immune system	0.031	Background[ac]	0.7	B
Aroclor 1268	Immune system	0.023	Background[ac]	0.1	B
Arsenic	Skin	3.9	Background[a]	0.03	A
2,3,7,8-Tetrachlorodibenzo-p-dioxin[2]	Reproductive/ Endocrine	0.000015	Background[a]	1	C
Coplanar PCBs (TEQ)[3]	--	0.000025	Background[a]	--	D
			HI Kidney	**0.00008**	
			HI Liver	**0.2**	
			HI Immune System	**0.8**	
			HI Skin	**0.03**	
			HI Reproductive	**1**	

Notes:

1. Cleanup levels are based on an evaluation of risk-based PRGs, (developed for the most sensitive receptor and/or exposure pathway) TBCs and Site background data. Because there are no chemical-specific ARARs for sediment, ARARs are not included in this evaluation. Additional sampling will be performed during the design phase to verify background conditions and the statistical comparisons, and verify undetected contaminants using analytical methods capable of measuring concentrations at levels below the risk-based PRGs. These data will be evaluated to assess impacts, if any, to the cleanup levels.
2. Dioxin TEQ cleanup level for sediment is background level of 34 ng/kg. Background is used because human health risk-based PRG (combined fish diet and direct contact, 10^{-6}) is below upstream background value.
3. Coplanar PCBs (TEQ) will be included as part of the sediment dioxin TEQ cleanup level in the future data evaluations.

a. Background is used because human health risk based PRG (10^{-6}) is below upstream background value.
b. Background is used because ecological risk-based PRG (HI=1) is below upstream background value. Human health risk-based PRG (10^{-6}) is also below upstream background value.
c. Estimated regional background values derived by excluding elevated upriver background results collected between the Smithfield Wastewater Treatment Plant and Route 44.

Key:
A - Residual cancer risk and/or hazard index for direct contact; B - Residual cancer risk and/or hazard index for fish consumption; C - Residual cancer risk and/or hazard index for fish consumption and direct contact; D - Residual cancer risk and/or hazard index not calculated for Coplanar PCBs due to highly uncertain BSAFs. Use of this Cleanup Level with the existing BSAFs would be inconsistent with the previously calculated risk at Greystone Mill Pond (the background area); HI - Hazard Index; RME - Reasonable Maximum Exposure; mg/kg - milligrams/kilogram; PCB - polychlorinated biphenyl; TEQ - toxic equivalent

Table L-7. Allendale Pond Sediment Contact and Sediment Associated Prey Consumption by Ecological Receptors

Contaminant	Sediment Cleanup Level[1] (mg/Kg)	Basis	Residual Hazard Quotients[a]							
			Demersal Fish[b]		Pelagic Fish[b]		Piscivorous Wildlife[c]		Insectivorous Wildlife[d]	
2,3,7,8-TCDD[2]	0.000015	Background[e]	0.038	A	N/A		0.049	B	0.039	C
Aroclor 1254[3]	0.031	Background[eg]	0.14	A	N/A		0.10	B	-	
Total Aroclors[3]	0.060	Background[fg]	-		N/A		0.55	B	-	
Technical Chlordane	0.4	Background[f]	27	A	N/A		-		-	
Selenium	1.1	Background[f]	2.6	A	N/A		-		-	
Zinc	221	Background[f]	4.5	A	N/A		-		-	
		HI[h]	**30**				**0.7**		**0.04**	

Notes:

1. Cleanup levels are based on an evaluation of risk-based PRGs (developed for the most sensitive receptor and/or exposure pathway), TBCs and Site background data. Because there are no chemical-specific ARARs for sediment, ARARs are not included in this evaluation. Additional sampling will be performed during the design phase to verify background conditions and the statistical comparisons, and verify undetected contaminants using analytical methods capable of measuring concentrations at levels below the risk-based PRGs. These data will be evaluated to assess impacts, if any, to the cleanup levels.
2. Dioxin TEQ cleanup level for sediment is background level of 34 ng/kg. Background is used because human health risk-based PRG (combined fish diet and direct contact, 10^{-6}) is below upstream background value.
3. The BERA evaluated risks for individual and Total Aroclors if benchmarks were available for a specific endpoint species.

a. Calculated by dividing the cleanup level by the PRG for the most sensitive measurement endpoint for each receptor category.
b. Sediment concentrations protective of demersal and pelagic fish were derived using (A) literature-derived CBR; the basis (*i.e.*, most protective of available PRGs) for the residual hazard calculation indicated. The white sucker and large-mouth bass are representative receptor species for these two assessment endpoints, respectively.
c. Sediment concentrations protective of piscivorous wildlife were derived using: (B) dietary exposure modeling. The belted kingfisher is the representative receptor species for this assessment endpoint.
d. Sediment concentrations protective of insectivorous wildlife were derived using: (C) literature-derived CBR; the basis (*i.e.*, most protective of available PRGs) for the residual hazard calculation indicated. The tree swallow is the representative receptor species for this assessment endpoint.
e. Background is used because human health risk-based PRG (10^{-6}) is below upstream background value.
f. Background is used because ecological risk-based PRG (HI=1) is below upstream background value. For technical chlordane, human health risk-based PRG (10^{-6}) is also below upstream background value.
g. Estimated regional background values derived by excluding elevated upriver background results collected between the Smithfield Wastewater Treatment Plant and Route 44.
h. Values reported as one significant figure.

Key: PCB - polychlorinated biphenyl; TEQ - Toxic Equivalent; N/A - not applicable

Table L-8. Lyman Mill Pond Sediment and Sediment Associated Fish Consumption for a Resident Living Along the River

Carcinogenic Contaminant	Cancer Classification	Sediment Cleanup Level[1] (mg/Kg)	Basis	RME Residual Cancer Risk	
Benzo(a)pyrene	B2	1.4	Background[a]	4.E-06	C
Dibenz(a,h)anthracene	B2	0.97	Background[a]	2.E-06	A
N-Nitroso-di-n-propylamine	B2	0.46	HH Risk	1.E-06	A
Dieldrin	B2	0.0026	Background[a]	2.E-06	B
Technical Chlordane	B2	0.4	Background[b]	8.E-06	B
Aroclor 1254	B2	0.031	Background[ac]	8.E-06	B
Aroclor 1268	B2	0.023	Background[ac]	2.E-06	B
Arsenic	A	3.9	Background[a]	1.E-06	A
2,3,7,8-Tetrachlorodibenzo-p-dioxin[2]	B2	0.000015	Background[a]	3.E-05	C
Coplanar PCBs (TEQ)[3]	B2	0.000025	Background[a]	--	D
			Sum of Carcinogenic Risk	**6.E-05**	

Non-Carcinogenic Contaminant	Target Endpoint	Sediment Cleanup Level (mg/Kg)	Basis	RME Residual Hazard Index	
Benzo(a)pyrene	Kidney	1.4	Background[a]	0.0001	C
Dibenz(a,h)anthracene	Kidney	0.97	Background[a]	0.00008	A
N-Nitroso-di-n-propylamine	--	0.46	HH Risk	--	E
Dieldrin	Liver	0.0026	Background[a]	0.007	B
Technical Chlordane	Liver	0.4	Background[b]	0.1	B
Aroclor 1254	Immune system	0.031	Background[ac]	0.7	B
Aroclor 1268	Immune system	0.023	Background[ac]	0.1	B
Arsenic	Skin	3.9	Background[a]	0.03	A
2,3,7,8-Tetrachlorodibenzo-p-dioxin[2]	Reproductive/ Endoctrine	0.000015	Background[a]	1	C
Coplanar PCBs (TEQ)[3]	--	0.000025	Background[a]	--	D
			HI Kidney	**0.0002**	
			HI Liver	**0.2**	
			HI Immune System	**0.8**	
			HI Skin	**0.03**	
			HI Reproductive	**1**	

Notes:

1. Cleanup levels are based on an evaluation of risk-based PRGs (developed for the most sensitive receptor and/or exposure pathway), TBCs and Site background data. Because there are no chemical-specific ARARs for sediment, ARARs are not included in this evaluation. Additional sampling will be performed during the design phase to verify background conditions and the statistical comparisons, and verify undetected contaminants using analytical methods capable of measuring concentrations at levels below the risk-based PRGs. These data will be evaluated to assess impacts, if any, to the cleanup levels.
2. Dioxin TEQ cleanup level for sediment is background level of 34 ng/kg. Background is used because human health risk-based PRG (combined fish diet and direct contact, 10^{-6}) is below upstream background value.
3. Coplanar PCBs (TEQ) will be included as part of the sediment dioxin TEQ cleanup level in the future data evaluations.

a. Background is used because human health risk-based PRG (10^{-6}) is below upstream background value.
b. Background is used because ecological risk-based PRG (HI=1) is below upstream background value. Human health risk-based PRG (10^{-6}) is also below upstream background value.
c. Estimated regional background values derived by excluding elevated upriver background results collected between the Smithfield Wastewater Treatment Plant and Route 44.

Key:
A - Residual cancer risk and/or hazard index for direct contact; B - Residual cancer risk and/or hazard index for fish consumption; C - Residual cancer risk and/or hazard index for fish consumption and direct contact; D - Residual cancer risk and/or hazard index not calculated for Coplanar PCBs due to highly uncertain BSAFs. Use of this cleanup level with the existing BSAFs would be inconsistent with the previously calculated risk at Greystone Mill Pond (the background area); E - RME Residual Hazard Index not calculated for this compound due to lack of noncarcinogenic toxicity data; HI - Hazard Index; RME - Reasonable Maximum Exposure; mg/kg - milligrams/kilogram; PCB - polychlorinated biphenyl; TEQ - toxic equivalent

Table L-9. Lyman Mill Pond Sediment Contact and Sediment Associated Prey Consumption by Ecological Receptors

Contaminant	Sediment Cleanup Level[1] (mg/Kg)	Basis	Residual Hazard Quotients[a]							
			Demersal Fish[b]		Pelagic Fish[b]		Piscivorous Wildlife[c]		Insectivorous Wildlife[d]	
2,3,7,8-TCDD[2]	0.000015	Background[e]	0.028	A	0.012	A	0.042	C	0.067	D
Coplanar PCBs (TEQ)[3]	0.000025	Background[e]	0.049	B	-		0.21	C	0.46	D
Aroclor 1254[4]	0.031	Background[eg]	0.11	A	-		0.076	C	-	
Total Aroclors[4]	0.060	Background[fg]	-		-		0.43	C	-	
Technical Chlordane	0.4	Background[f]	29	A	13	A	0.11	C	-	
4.4'-DDE	0.006	Background[f]	0.43	A	-		1.8	C	-	
4,4'-DDD	0.0084	Kingfisher diet	0.40	A	-		1.0	C	-	
Aluminum	8210	Background[f]	7.6	A	8.4	A	-		-	
Barium	134	Background[f]	9.3	A	16	A	-		-	
Selenium	1.1	Background[f]	2.3	A	-		-		-	
Vanadium	37.6	Background[f]	1.3	A	1.7	A	-		-	
Zinc	221	Background[f]	6.1	A	6.1	A	-		-	
		HI[h]	**60**		**50**		**4**		**0.5**	

Notes:

1. Cleanup levels are based on an evaluation of risk-based PRGs (developed for the most sensitive receptor and/or exposure pathway) and Site background data. Because there are no chemical-specific ARARs for sediment, ARARs are not included in this evaluation. Additional sampling will be performed during the design phase to verify background conditions and the statistical comparisons, and verify undetected contaminants using analytical methods capable of measuring concentrations at levels below the risk-based PRGs. These data will be evaluated to assess impacts, if any, to the cleanup levels.
2. Dioxin TEQ cleanup level for sediment is background level of 34 ng/kg. Background is used because human health risk-based PRG (combined fish diet and direct contact, 10^{-6}) is below upstream background value.
3. Coplanar PCBs (TEQ) will be included as part of the sediment dioxin TEQ cleanup level in the future data evaluations.
4. The BERA evaluated risks for individual and Total Aroclors if benchmarks were available for a specific endpoint species.

a. Calculated by dividing the cleanup level by the PRG for the most sensitive measurement endpoint for each receptor category.
b. Sediment concentrations protective of demersal and pelagic fish were derived using: (A) literature-derived CBR and (B) site-specific ELS thresholds; the basis (*i.e.*, most protective of available PRGs) for the residual hazard calculation indicated. The white sucker and large-mouth bass are representative receptor species for these two assessment endpoints, respectively.
c. Sediment concentrations protective of piscivorous wildlife were derived using: (C) dietary exposure modeling. The belted kingfisher is the representative receptor species for this assessment endpoint.
d. Sediment concentrations protective of insectivorous wildlife were derived using: (D) literature-derived CBR; the basis (*i.e.*, most protective of available PRGs) for the residual hazard calculation indicated. The tree swallow is the representative receptor species for this assessment endpoint.
e. Background is used because human health risk-based PRG (10^{-6}) is below upstream background value.
f. Background is used because ecological risk-based PRG (HI=1) is below upstream background value. For technical chlordane and 4,4'-DDE, human health risk-based PRG (10^{-6}) are also below upstream background value.
g. Estimated regional background values derived by excluding elevated upriver background results collected between the Smithfield Wastewater Treatment Plant and Route 44.
h. Values reported to one significant figure.

Key: HI - Hazard Index; mg/Kg - milligrams/kilogram; PCB - polychlorinated biphenyl; TEQ - Toxic Equivalent; N/A - not applicable

REGION 1

RECORD OF DECISION

CENTREDALE MANOR RESTORATION PROJECT
SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

SEPTEMBER 2012