THE PAPER TASK FORCE MEMBERS

Each Paper Task Force member organization dedicated to the project a team of individuals who worked with people from other member organizations and collectively wrote this report. These individuals are listed below.

Duke University

Paul Brummett is the director of the Material Support Department at Duke University. In this capacity, he is responsible for purchasing and materials services. Over the past 30 years, Mr. Brummett has headed Purchasing/Materials Management operations at York Division of Borg Warner Corporation, the University of Rochester and Duke University. He holds bachelor's and master's degrees from Ball State University.

Evelyn Hicks is a senior buyer in the Material Support Department with 29 years of experience in purchasing. She is responsible for the purchase of forms and other paper requirements.

Environmental Defense Fund (EDF)

Lauren Blum is a senior scientist in the Environmental Defense Fund's New York City office. Before joining EDF in 1992, she was an associate in the Energy and Chemicals Group at Booz•Allen & Hamilton, Inc., a management consulting firm in New York City. Dr. Blum has an A.B. in chemistry from Harvard University, a Ph.D. in inorganic chemistry from the Massachusetts Institute of Technology and a master's degree in public and private management from Yale University.

Robert Bonnie is an economist for the Environmental Defense Fund and focuses on land incentives for endangered species protection. Mr. Bonnie has master's degrees in resource economics and forestry from Duke University and a bachelor's degree in American history from Harvard University.

Richard A. Denison is a senior scientist at the Environmental Defense Fund in Washington, D.C., where his areas of work include materials use policy and waste management. He has authored many papers on waste reduction, recycling, incineration and landfilling, and has co-authored a recent book entitled *Recycling and Incineration: Evaluating the Choices* (1991). Dr. Denison, who holds a doctorate in biochemistry from Yale University, was a member of EDF's joint waste reduction task force with McDonald's Corporation.

Nat Keohane joined the Environmental Defense Fund as a research assistant on the Paper Task Force. He graduated from Yale College with a degree in history and studies of the environment and worked at the Environmental Working Group in Washington, D.C. Mr. Keohane currently is a first-year Ph.D. student in the political economy and government program at Harvard University.

Annette Mayer-Ilmanen holds a master's degree in economics and business from the University of St. Sallen, Switzerland, and a M.B.A. from the University of Chicago. Before joining the Environmental Defense Fund's New York office, Ms. Mayer-Ilmanen worked for four years as a management consultant at the Boston Consulting Group in Germany and Chicago.

Jane B. Preyer is a public policy specialist in the Environmental Defense Fund's North Carolina office. She was the project coordinator for the Paper Task Force. Ms. Preyer received her B.A. and master of public administration degrees from the University of North Carolina at Chapel Hill.

John F. Ruston is an economic analyst in the Environmental Defense Fund's New York office. Mr. Ruston was a member of the EDF-McDonald's waste reduction task force. He has worked on recycling issues in New York City and is co-author of *Recycling and Incineration: Evaluating the Choices* (1991). Mr. Ruston holds a master of city planning degree (environmental policy specialization) from MIT, and received his B.S. from the University of California at Davis.

Melinda Taylor is the director of and senior attorney at the North Carolina office of the Environmental Defense Fund. She oversees that office's work on air quality, water, wetlands,

wildlife and toxics issues. Before joining EDF, Ms. Taylor was a partner in the Austin, Texas law firm Henry, Lowerre & Taylor. Prior to that, she was the deputy general counsel of the National Audubon Society in Washington, D.C. Ms. Taylor received her B.A. and J.D. degrees from the University of Texas at Austin.

Johnson & Johnson (J&J)

Harold J. Capell is currently vice president, engineering and operations support, for Johnson & Johnson's Worldwide Absorbent Products and Materials Research organization. For more than 20 years he has held numerous manufacturing, purchasing and engineering positions within J&J's absorbent products businesses. In his current position, Mr. Capell is responsible for manufacturing process improvements for the worldwide feminine hygiene and incontinence products businesses.

Brenda S. Davis is vice president, government operations, and a member of the management board of Johnson & Johnson Health Care Systems, Inc. She is responsible for government sales, state government affairs, reimbursement services and pharmaceutical rebate management for the domestic health care businesses. Dr. Davis previously was a visiting fellow at Princeton University, served in the cabinet of Governor Thomas H. Kean of New Jersey and was a senior staff member of the U. S. Senate Committee on the Budget. She holds a Ph.D. in ecology from the University of California at Berkeley.

Barbara M. Greer, an attorney and professional planner, is an environmental consultant to Johnson & Johnson. In addition to her other duties, Ms. Greer assists the J&J Paper Task Force team. Prior to becoming an independent consultant, Ms. Greer was, successively, chief regulatory officer of the New Jersey Department of Environmental Protection and deputy chief of policy and planning for Governor Thomas H. Kean of New Jersey.

Anthony A. Herrmann is vice president, worldwide environmental affairs for Johnson & Johnson. He is an associate clinical professor, Department of Environmental and Community Medicine, Robert Wood Johnson Medical School. Dr. Herrmann has extensive research experience in the field of environmental toxicology.

Peter Turso is director of strategic sourcing at Johnson & Johnson's world headquarters in New Brunswick. He has 15 years experience dealing with the pulp and paper industry in a variety of procurement positions. Mr. Turso is also responsible for coordination of fiber packaging purchases in the U.S. and Europe.

McDonald's Corporation

Linda Croft joined the Perseco Company, the exclusive packaging purchaser for McDonald's, in 1988 and is responsible for managing a full range of projects related to environmental and regulatory issues for Perseco and McDonald's. Ms. Croft received her B.A. from the University of Notre Dame and, at the completion of the Paper Task Force, will leave McDonald's to pursue a master's degree in wildlife biology.

Bob Langert, as director of environmental affairs for McDonald's Corporation, has led the company's environmental programs and initiatives since 1991. Mr. Langert headed McDonald's environmental management of packaging beginning in 1988, after joining the McDonald's system in 1983, working in various distribution and transportation management functions.

The Prudential Insurance Company of America

Joe DeNicola is a vice president in The Prudential's financial restructuring group where he manages a portfolio of independent energy projects. In addition to his portfolio responsibilities, Mr. DeNicola has been involved with several environmental initiatives at The Prudential. Mr. DeNicola received a B.A. degree in chemistry from Yale University in 1986 and expects to complete a master's of forestry degree at the Yale School of Forestry and Environmental Studies in 1996.

Steve Ritter is an associate manager in The Prudential's supplier management & purchasing services division. Mr. Ritter oversees vendor relations and purchasing for a number of paper products including copy paper, personalized stationery and other printed materials. He received a B.S. in finance and management information systems from the State University of New York at Buffalo in 1988 and has been with The Prudential for six years.

Time Inc.

David J. Refkin is director of paper purchasing and environmental affairs for Time Inc. In addition to his responsibilities for purchasing magazine and book paper, he has served as a member of numerous committees on issues concerning paper and the environment, including the Recycling Advisory Council. Mr. Refkin, a C.P.A., holds a B.S. in accounting from the State University of New York at Albany and a M.B.A. in finance from Iona College. He is completing his studies in the strategic environmental management program at New York University.

David Rivchin has been in publishing and paper purchasing for more than 20 years. He has worked at Time Inc., Book of the Month Club, Random House and Scholastic Inc. Mr. Rivchin earned his bachelor's degree from Boston University.

EXPLANATION OF KEY TERMS AND ABBREVIATIONS

Note: Terms listed and defined below are in **boldface**. Terms which may be of particular interest to the reader in a given context, but are not defined below, are in *italics.*

Adsorbable organic halogens (AOX): Measure of the total amount of halogens (chlorine, bromine and iodine) bound to dissolved or suspended organic matter in a wastewater sample. For pulp, paper and paperboard wastewaters, essentially all of the organic substances measured as AOX are chlorinated compounds that result from the bleaching of pulps with chlorine and chlorinated compounds such as chlorine dioxide and hypochlorite. AOX provides information about the quantity of chlorinated organic compounds in wastewater, and thus contains a broad mix of compounds that have different chemical properties. The actual composition of AOX in pulp mill effluent varies from mill to mill, depending on the wood species used and the process parameters.

"Although AOX concentrations can be used to determine the removal of chlorinated organics to assess loading reductions, they do not provide information on the potential toxicity of the effluent, and therefore, are not appropriate to evaluate the potential impacts on the environment. Although no statistical relationship has been established between the level of AOX and specific chlorinated organic compounds, AOX analysis can be an inexpensive method for obtaining the 'bulk' measure of the total mass of chlorinated organic compounds." (U.S. EPA, *Regulatory Impact Assessment of Proposed Effluent Guidelines and NESHAP for the Pulp, Paper and Paperboard Industry,* (Washington: Office of Water, EPA-821-R93-020, November 1993), pp. 7-25 - 7-26)

AF&PA: American Forest & Paper Association

Agricultural residues: By-products from the production of food and other crops that contain fibers that can be used for papermaking.

Air-dried metric tons (ADMT): Pulp with 10% water content by weight. One ADMT is equivalent to 0.9 oven-dried metric ton of pulp (ODMT).

Air-dried tons of final product (ADTFP/ADMTFP): Tons or metric tons of final product made at a mill.

Alkaline papermaking: Process of producing papers under neutral or alkaline conditions. The major force behind the conversion from acid to alkaline papermaking is the greater strength of the alkaline sheet, which permits higher levels of clay and calcium carbonate filler. Additionally, maintenance costs for alkaline papermaking are less because such systems are less prone to corrosion, and are more easily closed than acid systems.

Alum: Also called *aluminum sulfate*. (1) Chemical release agent, used when pure fiber furnish is run at low basis weight to prevent sticking to the paper machine presses. (2) Papermaking chemical commonly used for precipitating rosin sizing onto pulp fibers to impart water-resistant properties to the paper.

American Forest & Paper Association: The trade association for the U.S. pulp, paper and forest products industry.

Anaerobic: Biochemical process or condition occurring in the absence of oxygen.

Anthraquinone: Chemical added to the digester that increases the amount of lignin removed from kraft pulp while maintaining its strength.

Artificial regeneration: Method for producing a new stand of trees following harvesting, in which tree seedlings (or more rarely, seeds) are planted. Most often used in even-aged silvicultural systems.

Ash: Inorganic matter present in the paper sheet, such as clay or titanium dioxide.

Base stock: Paper that will be further processed, as in coating or laminating.

Basis weight: The weight of a ream (500 sheets) or other standardized measure of a paper. Calculations are based on different sheet sizes, because paper mills produce the larger-size sheets and then ship them to converters, who cut the sheets to standard letter or legal sizes. A proposed international standard unit for basis

weight is called *grammage*, which is grams per square meter; this international standard unit is not widely used in the U.S.

Beating: The mechanical treatment given papermaking materials to prepare them for forming on the paper machine into paper or board of precise characteristics.

Bedding: Site-preparation technique in which soil is raised from a few inches to a few feet high to provide an elevated planting or seed bed; used primarily in wet areas to improve drainage and aeration for seeding.

Best Management Practices or BMPs: In this report, forestry practices specified in state-level forest management guidelines or legislation. BMPs encompass the practices required by the mandatory forest practice acts in some states as well as the voluntary or quasi-regulatory BMP programs in other states.

Biochemical oxygen demand (BOD): Amount of oxygen required by aerobic (oxygen-requiring) organisms to carry out normal oxidative metabolism or the amount required by oxidation of metabolic by-product from anaerobic organisms in water containing organic matter. Thus, BOD measures the amount of dissolved organic material that is degraded naturally once it enters a mill's receiving waters. For regulatory purposes, BOD is most often measured over a five-day period in the United States. The BOD in a test bottle can consume oxygen well in excess of 100 days, and the five-day test may capture only 50-75% of the total BOD.

Biodiversity: Most broadly, biodiversity encompasses the diversity of life on the planet. Biodiversity includes *genetic diversity*, the diversity of information encoded in genes within a species; species diversity, the diversity and relative abundance of species; and community/ecosystem diversity, the diversity of natural communities.

Biomass: Mass of organic matter. E.g., the "biomass removed in harvesting" refers to the amount of organic matter — mostly wood in trees, but also twigs and leaves — removed at harvest.

Black liquor: Spent, lignin-rich cooking liquor generated in the kraft pulping process.

Bleached chemi-thermomechanical pulp: A stronger and brighter variation of chemi-thermomechanical pulp (TMP), a pulp that reduces energy consumption for certain paper grades by combining thermal pretreatment with chemical methods.

Bleaching: Chemical treatment of pulp fibers for the purpose of: (1) increasing pulp brightness, (2) improving cleanliness by disintegrating contaminating particles such as bark, and (3) improving brightness stability by reducing the tendency of bleached pulp to turn yellow. Bleaching removes residual lignin.

Bonding strength: Cohesiveness of fibers within a paper. Paper with good bonding strength will not pick during the printing process.

Book paper: Also called text paper. Any type of paper suitable for printing, exclusive of newsprint and boards.

Boxboard: Paperboard used to make folding boxes, set-up boxes and carton stock. May be plain, lined or clay-coated.

Brightness: Light-reflecting property of paper or pulp. Brightness measurements compare paper and pulp with a reference standard (measured on a scale of 1 to 100 where 100 represents the reflectance of magnesium oxide). Bleached kraft pulps range in brightness from the low 80s to over 90. Unbleached mechanical pulps range from 55 to 62.

Broke: Machine trim or damaged paper that is pulped and returned to the papermaking process within the mill.

Broker: Purchaser of secondary materials who sells the materials to manufacturers. Brokers typically do not process raw materials for resale.

Buffer strip: See streamside management zone.

Bulk: Thickness of a sheet of paper in relation to its weight.

Bursting strength: Measurement of the strength of a piece of paper to withhold pressure.

Business papers: Office papers such as reprographic paper, letterhead, and envelopes designed to run in copiers and laser and ink-jet printers. May include some offset grades such as offset business forms and envelopes.

Buy-back center: Facility that purchases secondary materials, usually from the public, and resells them to brokers or manufacturers. Buy-back centers may or may not process the recyclables.

Cable logging: System of transporting logs from stump to landing by means of steel cables and winch. This method is usually preferred on steep slopes, in wet areas, and for erodible soils where tractor logging cannot be carried out effectively.

Calender: Also called *calender stack*. Vertical stack of sheet or cast-iron rolls, in the dry end of the machine, through which the paper sheet is passed for smoothing and gloss improvement.

Calendering: The process of passing paper through an assembly of rolls that have polished surfaces. The rolls compact and smooth the paper, increasing the sheet's gloss and smoothness.

Caliper: Sheet thickness measured under specified conditions, usually expressed in thousandths of an inch (points or mils).

Capacity: The amount of pulp, paper or paperboard that a paper machine or mill is capable of producing over an extended period of time with the full use of its equipment, adequate raw materials and labor and full demand for its products. Capacity usually is slightly higher than actual production.

Carbon black: Finely processed forms of carbon derived from the incomplete combustion of natural gas or petroleum; used principally in ink and rubber.

Carbon dioxide (CO_2): Greenhouse gas associated with global climate change that results from the complete combustion of biomass and fossil fuels.

Cellulose: Polymer of sugar units that forms transparent, hollow and flexible tubes. It is the most abundant natural polymer produced by plants.

Chemi-thermomechanical pulp (CTMP): Variation of thermomechanical pulp (TMP) produced by pulping that reduces energy consumption for certain paper grades by combining thermal pretreatment with chemical methods. A stronger and brighter version of CTMP is bleached chemi-thermomechanical pulp (BCTMP).

Chemical oxygen demand (COD): Amount of oxidizable compounds (composed of carbon and hydrogen) present in the water. Since an effluent-treatment system removes most of the organic material that would be degraded naturally in the receiving waters, the COD of the final effluent provides information about the quantity of more persistent substances discharged into the receiving water.

Chemical pulp: Pulp produced from wood that has been cooked with various chemicals; used to produce many grades of printing papers and some paperboard grades, such as SBS.

Chipboard: Low-density board made from waste paper; used in low strength applications.

Chlorine: See elemental chlorine.

Chlorine dioxide (ClO_2): Powerful oxidizing agent used to delignify and remove colored substances from pulp. The oxygen in chlorine dioxide initially reacts with lignin. This initial reaction produces substances that can chlorinate the remaining organic material.

Chloroform: A hazardous air pollutant, is classified as a probable human carcinogen. The units of measure are pounds per oven-dried ton of pulp.

Chopping: Mechanical site preparation treatment whereby remaining vegetation is concentrated near the ground and incorporated into the soil to facilitate burning or establishment of seedlings.

Clarifier: Process water storage tank in which suspended solids are allowed to settle.

Clay: Natural, fine-grained material used as filler and as coating pigments in paper manufacture.

Clean Air Act: Federal statute that gives the U.S. Environmental Protection Agency the authority to regulate emissions of air pollutants from all sources in the United States. The purpose of the statute is to protect and enhance the quality of the nation's air resources. 42 U.S.C. §§ 7401 to 7642.

Clean Water Act: Federal statute that gives the U.S. Environmental Protection Agency the authority to regulate discharges of pollutants from all sources into waters of the United States. The purpose of the statute is to restore and maintain the chem-

ical, physical and biological integrity of the nation's waters. 33 U.S.C. §§ 1251 to 1387.

Clearcutting: Harvesting/regeneration method in which all merchantable trees (commercial clearcutting) or all trees (silvicultural clearcutting) in a stand are harvested in one operation. Clearcutting is also used in even-aged silviculture to regenerate an even-aged stand of desired shade-intolerant trees. In practice, most clearcuts are commercial clearcuts.

Coarse woody debris: Also called large *woody debris*. Downed large wood on the forest floor, such as fallen trees and limbs. When such debris falls into streams, it creates waterfalls and pools — important physical structures for fish habitat and other stream functions. In natural forests of some regions (e.g., the Pacific Northwest), coarse woody debris on the forest floor also provides important functions as it slowly decays, returning nutrients to the soil, storing water for use in dry periods, and providing animal habitat. Coarse woody debris develops naturally in unmanaged forests, as trees die and decay, and may also be created by forest management (see also Logging debris).

Coastal Zone Management Act: Federal statute that requires states to formulate programs to reduce water pollution from nonpoint sources impacting coastal waters, including forestry activities. State management measures can include land use management restrictions and control measures similar to the Best Management Practices developed under the authority of the Clean Water Act. 16 U.S.C. 1451 *et seq.*

Coated freesheet: Coated papers containing 10% or less of mechanical pulp (mostly stone groundwood and/or refiner) in their furnish.

Coated groundwood: Coated papers containing more than 10% mechanical pulp (mostly stone groundwood and/or refiner). Coated groundwood papers also contain softwood bleached kraft pulp to minimize breaks in the printing press.

Coated paper: Paper or paperboard that has been coated to improve printability and appearance. Paper may be coated on one or both sides.

Coating: (1) Act of applying a coating to the surface of paper or paperboard. (2) Material used as a coating; clay is the most commonly used coating.

Cockle: Ripple or waviness of a sheet caused by improper drying.

Color: Used to describe colored wastewater discharge from chemical pulping, pulp bleaching or colored-paper manufacture. The wastewater is colored by the lignin and lignin derivatives present in spent cooking liquors.

Commercial printing: Wide array of promotional literature, including annual reports and direct mail products not included under catalogs, such as materials sent out in bulk mail by banks, financial services companies, credit-card marketers and others. Commercial printing products use both uncoated and coated papers.

Commercial thinning: Silvicultural practice performed in even-aged forests in which some merchantable trees are harvested, usually for pulpwood, to provide greater light, soil moisture and nutrients to the remaining stand.

Commodity grade: Mass-produced paper grades, typically made at large pulp and paper mills. Includes grade with more than 1.5 million tons per year of total production in the United States, such as linerboard, newsprint, and the major uncoated freesheet grades (e.g., 20 lb. cut-size, 50 lb. offset).

Community: Collection of animal and plant species present in a given location; generally viewed as also encompassing the interactions between different species.

Compost: (1) Nutrient-rich mulch of organic soil produced through aerobic digestion of mixtures of food, wood, manure and/or other organic material. (2) The process of producing compost.

Consistency: The percentage of cellulose fibers in a pulp slurry.

Containerboard: Single-ply and multi-ply combinations of linerboard, and corrugating medium used to make boxes and other shipping containers.

Conversion: Transformation of large rolls of paper or paperboard into a variety of products, such as forms, envelopes, bags, boxes and folding cartons.

Converter: Company that converts paper from its original form into usable products like bags and boxes.

Cook: To treat wood with chemicals, under pressure and/or extreme heat, to produce pulp for making paper and paperboard.

Cooking liquor: Chemical solution used to pulp wood.

Core: In the center of a roll, the shaft around which the web of paper is wound. Cores are either metal or cardboard and are either returnable or disposable.

Corrugating medium: Paperboard (made from chemical, semi-chemical and/or recycled pulps) that is passed through a fluting machine and used as the middle layer of corrugated boxes.

CUK: Coated unbleached kraft paperboard. Also known as solid unbleached sulfate or coated natural kraft paperboard. The abbreviations "SUS" and "CNK" are trademarks.

Cumulative effect: Impact on the environment that results from the incremental impact of an action when added to other past, present and reasonably foreseeable future actions.

Curl: In a photocopy machine, *output curl* is a result of an interaction of the heating in the fuser with the paper's structure and moisture content. Curl that is built into the paper as packaged is called *as-packaged curl*.

Cylinderboard: Paperboard made on a cylinder machine.

Cylinder machine: An older paper machine technology used primarily to make 100% recycled paperboard. In such a machine, 6-9 rotating mesh cylinders are immersed in vats of pulp; the paperboard is formed as water drains from the cylinder. The wet sheet is transferred off the cylinder onto a felt or onto other sheets to make a multi-layer product. Pressing and drying follow this step.

Deinked market pulp (DMP): Pulp made from recovered paper by mills that receive high-grade recovered papers and remove the ink and contaminants. DMP is produced in sheets as *wet-lap pulp* (about 50% moisture) or air-dried form and is sold to paper producers who blend it with virgin pulp for use on existing paper machines.

Deinking: Separation and removal prior to paper formation of ink and other contaminants from wastepaper slurry by screening, washing, flotation, chemical treatment and bleaching.

Delignification: The process of removing lignin from wood or non-wood fibers.

Density: The weight of a paper compared to its volume. Dense papers are made from well-beaten or hydrated pulp.

Die cut: Paper and paperboard products cut by a metallic die to specified dimensions or forms.

Digester: Pressurized vessel in which wood chips are cooked to separate fibers from each other and to remove contaminants.

Dimensional stability: Ability of paper to retain its dimensions in all directions under the stress of production and changes in humidity. This property allows paper to resist curl and cockle. Resistance to curl is extremely important, as curl is a major cause of copy machine jams. Dimensional stability is also determined by a sheet's reactivity and paper formation.

Dioxins: A group of persistent, toxic substances, including furans, that are produced in trace amounts when unbleached pulp is exposed to elemental chlorine. Term used to describe the families of chemicals known as chlorinated dibenzo-p-dioxins and dibenzo-p-furans. These families consist of 75 different chlorinated dibenzo-p-dioxins and 135 different chlorinated dibenzo-p-furans. These molecules can have from one to eight chlorine atoms attached to a planar carbon skeleton. 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF) are two of the most toxic members of this family of compounds. If dioxins are detected in the releases from bleaching processes that expose unbleached pulp to elemental chlorine, the dioxins are most likely to be TCDD and TCDF.

Dirt: Loose material from all manufacturing sources, e.g., slitter or trimmer dust, lint, starch, loose coating pigments and loosely bonded fibers. With respect to paper recycling, dirt can refer to a range of small contaminants.

Disking: Also called *harrowing*. Mechanical site preparation method of scarifying the soil (i.e., scraping to expose mineral

soil) to reduce competing vegetation and to prepare a site to be seeded or planted.

Downtime: Downtime occurs when a paper machine is stopped for repairs. Shutting down a paper machine for vacation or normal maintenance is referred to as *scheduled downtime.*

Drop out: Condition that occurs during photocopying when portions of originals do not reproduce, especially colored lines or background areas.

Dry end: Section of a paper machine where the driers, cutters, slitters and reels are located; the paper web is formed into a dry sheet in this part of the machine.

Dryers: Part of paper machine where water is removed from wet paper by passing it over rotating, steam-heated, cylindrical metal drums, or by running it through a hot air stream.

Ecosystem: Ecosystems encompass plant and animal communities and also include nonliving components, both structural (soil types) and functional (processes such as disturbance patterns and energy flows in and out of the ecosystem).

Effluent: Wastewater that has been discharged either to a sewer or to a stream or other body of water.

Electrical properties: Properties of paper that determine how it responds to an electrical charge, and how static electricity will be dissipated from the sheet. Electrical properties affect the quality of the image transfer in copy machines and laser printers. If the sheet does not exhibit uniform electrical properties, the result can be uneven application of toner on a page. Electrical properties are affected by the smoothness of the sheet, by surface sizing agents and by changes in moisture content.

Elemental chlorine: Chlorine gas (Cl_2).

Elemental chlorine-free (ECF): Bleaching processes that substitute chlorine dioxide for elemental chlorine and sodium hypochlorite in the bleaching process.

Endangered Species Act: Federal statute that seeks to protect plants and animals in danger of extinction (*endangered species*) or likely to become so (*threatened species*). It requires all federal agencies, including federal forestland managers, to ensure that their actions not jeopardize the continued existence of any endangered or threatened species. It also prohibits all persons (including public and private land owners) from "taking" any protected species, either directly or indirectly by destroying the habitat upon which the species depends. 16 U.S.C. 1531 *et seq*.

Even-aged management: Class of silvicultural systems that maintains even-aged stands by periodically removing the forest canopy in a single operation and regenerating a new stand at one time. Harvesting/regeneration methods used in even-aged management include clearcutting, the seed-tree method and the shelterwood method.

Feedstock: Raw material used to make paper or paperboard.

Feet per minute: Abbreviated as *fpm*, this term usually refers to the speed at which the forming paper web traverses the length of the paper machine.

Felt side: Top side (side opposite the wire) of a paper sheet. Felt is a woven belt made of cotton, metal or synthetic materials used to transport the paper web on the paper machine.

Fertilizer: Plant nutrients applied to forest soils, usually in chemical forms that are readily taken up by plants (e.g., phosphorus is applied as phosphate).

Fiber fractionation: Separation of pulp into a long and short fiber fraction. Used by paper and paperboard mills to direct long fibers to the outer plies and short fibers to the inner plies of a multi-ply board.

Fiber furnish: The pulps used to make paper or board.

Filler: (1) Substances, such as clay, precipitated calcium carbonate and other white pigments, added to pulp to improve a paper's printability. (2) Inner layers of multi-ply paperboards.

Filtrate: Water that is either pressed or washed out of the pulp during the pulping and bleaching; once the water has been discharged to a sewer it becomes effluent.

Fine papers: Printing and writing paper grades.

Finish: Surface contour and characteristics of a paper sheet measured in terms of smoothness, gloss, absorptiveness and print quality.

Finishing operations: Supplementary operations to printing such as binding, finishing and distribution. The demands of finishing and postpress operations include folding, die-cutting, cutting, trimming, scoring, stitching, gluing and perforating.

Flotation deinking: In a paper recycling system, removal of ink by a process of adding surfactants to the pulp and pumping bubbles of air through the mixture. The hydrophobic ink particles attach to the air bubbles, float to the surface of the pulp and are skimmed off.

Folding cartons: Paperboard boxes that are creased and folded to form containers that are generally shipped and stored flat and erected at the point where they are filled. Folding cartons are designed to contain and present products, and are generally small enough to hold in one hand.

Forest canopy: Topmost layer of tree vegetation, also called the overstory.

Formation: Term used to describe the process of forming the paper sheet or paperboard on a paper machine.

Fourdrinier machine: Paper machine comprised of a rapidly moving horizontal screen fitted with a headbox to meter the pulp onto the wire.

Freesheet: Paper that contains less than 10% groundwood pulp.

Freeness: Also called *drainage*. Ability of pulp and water mixture to release or retain water.

Fuelwood: Wood used for conversion to some form of energy, primarily residential use.

Functionality: Ability of a paper product to meet the user's performance requirements, such as running in office equipment, on an offset printing press, packaging consumer and industrial items, presenting a product or communication with a customer, and meeting the needs of the ultimate user.

Furans: See dioxins.

Furnish: Also called stock. Various pulps, dyes and additives blended together in the stock preparation area of a paper mill, and fed to the wet end of a paper machine to make paper or paperboard.

Groundwood pulp: Mechanical pulp produced by grinding pulpwood against a revolving grindstone, in the presence of water.

Group selection: Method of harvesting in which small groups of merchantable trees are cut periodically. Natural regeneration is typically relied on to fill in the resulting gaps.

Growing stock: Classification of timber inventory that includes live trees of commercial species meeting specified standards of quality or vigor; *cull trees* are excluded. When associated with volume, includes only trees 5.0" in *diameter at breast height* (d.b.h.) and larger.

Hardwood: Technically, a dicotyledonous tree. Hardwoods typically have broad leaves and are often *deciduous* (they lose their leaves during winter); e.g., maple, oak, aspen, cherry and ash.

Harvesting: In this report, the process of felling trees for removal and use. More broadly, may also be used to include related activities, such as the skidding, processing, loading and transporting of forest products.

Hazardous air pollutant (HAP): One of 189 toxic substances as defined by the 1990 Clean Air Act amendments.

Headbox: Box at the head of a fourdrinier machine that regulates the flow of pulp to the machine wire.

Heat-set inks: Inks used in high-speed web offset printing. They set rapidly under heat and are quickly cooled.

Herbicide: One of a group of chemicals used to kill or suppress unwanted vegetation, usually hardwood competition or brush.

Hickies: Blemishes or irregularities on the surface of the paper sheet.

Holdout: Ability of paper or board to resist penetration by liquid substances, such as ink.

Hot-melt glues: Rapidly setting glue made from plastic, resin and waxes melted at 350°F; frequently used to bind magazines and books. According to deinking experts, the most difficult contaminants to remove during deinking are the polymeric adhesives used as pressure sensitive adhesives and hot melt glues.

Hydrapulper: Large vat with agitator used to hydrate and prepare pulp or recovered paper for papermaking or fiber cleaning and processing.

Hydrogen peroxide (H_2O_2): Oxygen-based bleaching agent that removes colored substances but does not delignify pulp when used at low temperatures and pressures.

Hydrophilic: Affinity for water.

Hydrophobic: Aversion to water.

Ink holdout: Property of coated paper that allows ink to set on the surface with high gloss. If holdout is too high, it can cause set-off (transfer to the back of the previous sheet) in the paper pile.

Insecticide: One of a group of chemicals used to kill or control populations of unwanted insects.

Integrated mill: A mill that has facilities for producing both pulp and paper at the same site.

Intensive management: While forests can be intensively managed for any of a number of objectives, including wildlife habitat or recreation (e.g., hunting), "intensity" in the context of wood production relates to the extent to which specific yield-enhancing practices are employed. Intensity can characterize use of a particular practice, as well as the combination of practices that comprise the overall management system. It spans a spectrum from essentially unmanaged to highly intensive. At the latter end of the spectrum are softwood plantations which employ even-aged management and a suite of site preparation, artificial regeneration and stand-tending practices. Uneven-aged management systems may also vary in intensity with respect to, for example, the frequency of entries and the extent of removal of biomass at each entry.

Intermittent stream: Watercourse that flows in a well-defined channel only in direct response to precipitation; such a stream is dry for a large part of the year.

Job lot: Paper unsuitable for a customer's desired end use and usually sold at a discount. The term is also used to describe press overruns or defective and off-spec papers that are still usable.

Kaolin: White clay primarily comprised of the mineral kaolinite; used as a filler and coating pigment for papermaking.

Kraft mill: Mill that produces kraft pulp.

Kraft paper: High-strength paper made from unbleached sulfate (kraft) pulp; usually brown in color.

Kraft pulp: Also called sulfate pulp. Chemical pulp made using an alkaline cooking process with sulfur compounds. This pulp can be bleached or unbleached and is noted for its strength.

Landing: Also called *log deck* or *yard*. Place in or near the forest where logs are gathered for further processing or transport.

Latex: Milky substance, extracted from some species of rubber trees, used in the manufacture of paper and glue. Latex is used to make strong, durable, weather-resistant paper; latex glue is used to make self-seal envelopes.

lbsf/in: Pounds-force per square inch. A measure of bursting strength.

Leaching: Downward movement of a soluble material through the soil as a result of water movement.

Lightweight paper: Paper manufactured in weights below the minimum basis weight considered standard for that grade. High-brightness, high-opacity paper used by publishers of magazines, directories, Bibles, hymnals, reference books and catalogs.

Lignin: Complex organic material that binds together fibers in trees and woody plants.

Linerboard: Paperboard made from unbleached kraft pulp, recycled fibers, or a combination of the two, used to line or face corrugated core board (on both sides) to form corrugated boxes and other shipping containers.

Lint: Paper fragments or dust on the sheet. Excess lint can contaminate copiers and printers.

Lithography: Process of using a flat-surfaced plate that carries an image which is transferred to a blanket, then to paper. Also known as offset printing.

Logging debris: Also called slash. Accumulation of woody material, such as large limbs, tops, cull logs and stumps, that remains

as forest residue after stem-only timber harvesting (as opposed to whole-tree harvesting). Logging debris is typically removed, displaced into piles, chopped, or burned during site preparation.

Logging residues: In this report, the portion of logging debris that is merchantable and that is removed from the site to be chipped for pulpwood or other uses. Logging residues typically make up a small fraction of total pulpwood supply.

Machine clothing: Paper-machine felt and wire.

Machine coating: Coating applied while paper or board is still on the paper machine.

Makeready: All work done to set up a press for printing.

Market pulp: Pulp sold on the open market; virgin market pulp is air-dried and wrapped; deinked market pulp can be sold in air-dried or wet-lapped (partially dry) form.

Materials recovery facility (MRF): Facility that upgrades recyclable materials for resale to manufacturers by separating, cleaning and baling incoming materials.

Mature forest: Stage in forest development in which the original dominant trees in the forest canopy begin to die and fall, creating canopy gaps that allow understory trees to grow, and providing coarse woody debris on the forest floor. Corresponds roughly to understory regeneration stage. Sometimes used more broadly to include old-growth forest.

Mechanical pulp: Pulp produced by shredding pulpwood logs and chips using mechanical energy via grindstones (groundwood pulp) or refiners (thermomechanical pulp).

Merchantable: Commercially valuable; merchantable timber has potential for sale as sawtimber, pulpwood, fuelwood or other wood products.

Mineral soil: Soil free of organic matter that contains rock less than 2" in maximum dimension.

Mixed Paper: An inclusive, "catch all" or "what's left over" category for a wide variety of recovered paper blends. "Mixed paper" can refer to the commingled remnants of paper box-making or printing operations, or to office waste collected by haulers who removed some contaminants at a transfer station, or paper collected from households. The physical properties and intrinsic value of the paper are different in each case.

Moisture content: Percentage of moisture, by weight, found in a sheet of paper or paperboard, e.g., generally ranging from 5% to 8% in copy paper.

Multi-ply: Paper or paperboard sheet made of two or more layers.

Municipal solid waste (MSW): Includes durable goods, nondurable goods and containers and packaging that have served their useful life and have been discarded, plus food scraps and yard trimmings from residential, commercial and institutional sources. Strictly defined, MSW does not include construction and demolition debris, sludge, combustion ash and industrial process wastes.

Natural community: Discrete assemblage of interacting plants and animals, often referred to by their dominant plant associations: e.g., longleaf pine-wiregrass savanna; oak-hickory forest; beech-maple forest.

Natural disturbance: Naturally occurring events that disturb the forest by killing or felling one or more trees. *Natural disturbance regimes* — the typical natural disturbance patterns in a given region and forest type — vary by scale (individual tree mortality vs. wildfire over hundreds of acres), severity (light disturbance of the forest soil in a low-intensity fire vs. landslides that remove massive amounts of soil and organic matter, along with trees and vegetation), and frequency. Natural disturbance regimes typically determine the dominant forest types (which in turn help determine natural disturbance regimes): e.g., longleaf pine-wiregrass savannas in the southeast are maintained by and help to propagate frequent low-intensity ground fires.

Natural regeneration: Method for replacing trees removed through harvesting, in which new trees sprout from cut stumps or roots, or germinate from seeds present in the upper soil layer. May be used in both even-aged and uneven-aged silvicultural systems.

Newsprint: Relatively inexpensive groundwood paper made from mechanical pulp, thermomechanical pulp (TMP) or secondary fiber; used extensively by newspaper and directory pub-

lishers. Basis weights range from 30 to 35 lbs.

Nitrogen oxides (NO_x): Emissions that occur when fuels that contain nitrogen are burned. They also form at high temperatures from combustion of nitrogen in the air. Nitrogen oxides contribute to acid rain and can react with volatile organic compounds in the atmosphere to produce the ozone in photochemical smog.

Non-commercial species: Tree species typically of small size, poor form or inferior quality, that normally do not develop into trees suitable for industrial wood products.

Non-industrial private landowners: Private timberland owners other than forest-products companies and their subsidiaries.

Nutrients: Chemical elements required by plants for their growth and existence. Various nutrients are used for countless basic functions, such as manufacturing proteins and plant cells. The best-known plant nutrients include nitrogen and phosphorus. Low levels of key nutrients in soils can substantially limit plant growth and productivity. Nutrients may be added to soils in fertilizer to make up for inherent soil deficiencies.

OCC: Old corrugated containers.

Off-machine coating: Also known as *conversion coating*. Process of coating paper on a separate machine from the paper machine.

Office Paper: Wastepaper generated by offices, including stationery and computer paper.

Office pack: A more detailed definition of what is allowed and not allowed in sorted office paper developed by individual deinking mills for use by their recovered paper suppliers.

Offset paper: Paper made specifically for use on offset printing presses, characterized by strength, cleanliness, pick-resistance and relative freedom from curl. Offset paper must be relatively impervious to water.

Offset printing: Also called offset lithography or *photo-offset*. Indirect printing process that uses lithographic plates on which images or designs are ink-receptive; the rest of the plate is water-receptive. Ink is transferred from the plate to a rubber-blanketed cylinder that transfers (off-sets) the image to the paper.

Old-growth forest: The fourth and final stage of stand development, following mature forest, in which the forest canopy is generally composed of scattered remaining trees that assumed dominance following natural disturbance along with newly dominant, shade-tolerant trees. Other characteristics of old-growth forests may include accumulated coarse woody debris, snags and canopy gaps created by fallen trees. Because of these features, and the presence of an understory, old-growth forests generally exhibit complex stand vegetation, and provide habitat for many species. Development of old-growth forest generally takes from 100 to 200 years, with variation depending on forest type. The last remaining sizable area of old-growth forest in the contiguous United States lies in the Pacific Northwest; only a few small and isolated patches of old-growth remain in eastern forests. However, as a stage in stand development, old-growth forest could also develop in eastern forests (and was present in presettlement forests).

OMG: Old magazines.

ONP: Old newspapers.

Opacity: Also called *show-through*. Degree to which one is unable to see through the sheet; measured by the amount of light that transmits through a sheet. Opacity is a function of the type and amount of fiber, basis weight, sheet compaction, void volume and the inclusion of various fillers in the paper. Paper can have a maximum opacity of 100%, in which no light is transmitted at all. For duplexing and double-sided printing, opacity is an important characteristic.

Oven-dried ton/metric ton of pulp (ODTP/ODMTP): The moisture content of oven-dried pulp is zero. Air-dried pulps have about a 10% moisture content

Overstory: See forest canopy.

Ozone (O_3): Powerful oxidizing agent used in bleaching processes to remove lignin and colored substances from pulp. Ozone is formed by passing electricity through a stream of oxygen gas. Low-level atmospheric ozone is a pollutant in smog that results from the reaction of nitrogen oxides and volatile

organic compounds with sunlight.

Paper machine: Machine on which pulp is made into paper; a sheet is dried and wound on rolls. (See cylinder machine and fourdrinier machine.)

Paper: Medium formed primarily from cellulose fibers in a water suspension, bound together with additives and formed on a wire machine. General term designating one of the two broad classifications of paper; the other is paperboard.

Paperboard: Comparatively thick, strong paper used to make such products as packaging, corrugated boxes, folding cartons and set-up boxes.

Particulates: Small particles that are dispersed into the atmosphere during combustion.

Perennial stream: Watercourse that flows throughout most of the year in a well-defined channel.

Persistence: Ability of a substance to remain active over a period of time.

Pesticides: Chemicals used in silviculture to control unwanted insects (insecticides) or unwanted vegetation (herbicides).

PIA: Printing Industry of America.

Picking: Fibers in the paper that tend to pull away from the surface during the printing process. Picking occurs when the tack or pull of the ink is greater than the surface strength of the paper. An increase in surface pick resistance is commensurate with an increase in bonding strength. Pick resistance is important in office papers that are run through the reprographic process in which excessive linting can cause impairment of copies.

Plantation: Planted stand of trees.

Pocosin: Freshwater evergreen shrub or forested bog found in the Atlantic coastal plain of the southeastern United States, primarily in the Carolinas. The term is taken from the Algonquin Indian word meaning "swamp on a hill." Pocosins are generally found on flat, slightly elevated and very poorly drained areas between rivers, with either organic or acidic mineral soils.

Ply: One layer of paper or paperboard that makes up a multi-layer (multi-ply) sheet.

Point: One thousandth of an inch equals one point; used to denote the caliper measurement of paper and paperboard.

Polyethylene: Thermoplastic film applied to paper to make it suitable for packaging; also applied to foodboard for liquid resistance.

Postconsumer fiber: Finished paper products that have been sold in commerce and have served their original purpose. As contained in the Resource Conservation and Recovery Act (RCRA), postconsumer material is "paper, paperboard and fibrous wastes from retail stores, office buildings, homes and so forth after they have passed through their end-usage as a consumer item, including used corrugated boxes, old newspapers, old magazines, mixed waste paper, tabulating cards and used cordage; and all paper, paperboard and fibrous wastes that enter and are collected from municipal solid waste."

Postpress operations: Supplementary operations to printing such as binding, finishing and distribution. The demands of finishing and postpress operations include folding, die-cutting, cutting, trimming, scoring, stitching, gluing and perforating.

Precommercial thinning: Stand-tending method, performed relatively early in the rotation, in which a stand is thinned by cutting down poor-quality trees and unwanted species (usually left in the forest). Precommercial thinning is done to reduce competition among trees for soil moisture, nutrients, light and space.

Preconsumer fiber: Defined by the U.S. Environmental Protection Agency as "materials generated during any step of production of a product, and that have been recovered from or otherwise diverted from the solid waste stream for the purpose of recycling, but does not include those scrap materials, virgin content of a material or by-products generated from, and commonly used within, an original manufacturing process." For paper recycling, includes trim from converting envelopes, paper plates and cups, boxes and cartons and printing runs, and overissue publications and forms.

Prescribed burning: Managed application of low-intensity fire in a carefully prescribed area. Prescribed burning is done to control hardwoods and other brush in managed pine forests,

including plantations.

Press: Sets of rolls through which the paper web passes during manufacture. This process occurs either to remove water from the web in the wet press; to smooth and level the sheet's surface in the smoothing press; or to apply surface treatments to the sheet in the size press.

Pressure sensitive adhesives: Adhesives that are activated by applying pressure; usually used in the manufacture of labels and tapes. According to deinking experts, the most difficult contaminants to remove during deinking are the polymeric adhesives used as pressure sensitive adhesives and hot-melt glues.

Pressure sensitive labels: "Peel and stick" labels.

Print quality: Paper properties that determine the quality of appearance of the sheet after printing, as judged by contrast, resolution of the printed image, type and reproduction of halftones.

Print resolution: The appearance of color, halftones, line art and type on the sheet.

Printability: A paper's ink receptivity, uniformity, smoothness, compressibility and opacity.

Printing and writing papers: Broad category defined by the American Forest & Paper Association to include coated and uncoated freesheet and coated and uncoated groundwood grades; it excludes newsprint.

psi: Pounds pressure per square inch.

Publication papers: Paper grades used in magazines, books, catalogs, direct mail, annual reports, brochures, advertising pieces and other publication and commercial printing products.

Pulp: Cellulose fiber material, produced by chemical or mechanical means, from which paper and paperboard are manufactured. Sources of cellulose fiber include wood, cotton, straw, jute, bagasse, bamboo, hemp and reeds.

Pulpwood: Roundwood products, whole-tree chips, or wood residues that are used for the production of wood pulp.

Purchased energy consumption: Amount of purchased electricity and fossil fuels that mills use to run the equipment and to generate process steam. Cogeneration and more effecient combustion of lignin and other wood waste decreases the purchased energy consumption of the mill.

Rag paper: Paper made from cotton cuttings and linters; usually referred to as cotton-fiber paper.

Reactivity: Propensity of a sheet to gain and lose moisture when subjected to heat and/or changes in humidity.

Ream: 500 sheets of printing paper.

Recovered paper: Paper collected for the purposes of recycling.

Recycling: The process by which materials that would otherwise be destined for disposal are used to manufacture products. In basic terms, successful recycling requires that four things happen in sequence: (1) collection of recyclable materials; (2) intermediate processing to remove contaminants and to sort and compact materials for shipment; (3) manufacturing of new products; and (4) the purchase of products containing recovered materials by business and individual consumers.

Recycled-content paper: Paper that contains some recycled fiber.

Reel: Roll onto which paper is wound at the end of the paper machine.

Refiner mechanical pulp (RMP): Mechanical pulp made using a single-disk or double-disk refiner.

Regeneration: Establishment and early development of new tree seedlings. In unmanaged forests, regeneration takes place on a variety of scales — from individual trees to large areas of forest leveled by large-scale natural disturbance, such as wildfire. In managed forests, regeneration may be natural or "artificial" (performed through planting), and may occur at the level of an individual tree or small group of trees (following selection harvests in uneven-aged silviculture) or at the level of a stand (following clearcutting or other harvesting methods in even-aged silviculture).

Reprographic paper: Reprographic paper is multi-purpose paper designed for use in copy machines, laser printers, ink-jet printers

and plain paper faxes. It is often referred to as *dual purpose* paper.

Residues: Bark and woody materials that are generated in primary wood-using mills when roundwood products are converted to other products. Examples are slabs, edgings, trimmings, miscuts, sawdust, shavings, veneer cores and clippings and pulp screenings; includes mill residues from bark and wood (both coarse and fine material), but excludes logging residues, which are included in roundwood.

Resource Conservation Recovery Act (RCRA): Federal hazardous and solid waste statute enacted in 1976 and amended several times, most significantly in the Hazardous and Solid Waste Amendments of 1984. Codified as Title 42 of the United States Code, Sections 6901 - 6987.

Rigidity: Stiffness; resistance to bending.

Riparian zone: See streamside management zone.

Rotation: In even-aged silviculture, the period of time between harvests. (Related terms: *rotation age*, referring to the age at which a stand is harvested, and *rotation length*, the length in years of the rotation.) Where production of solid wood or fiber is the management objective, the rotation age is generally timed to maximize the net economic return from the stand, allowing for considerations such as mill supply and demand. Rotation ages for pulpwood management are significantly shorter than for sawtimber (although pulpwood may also be harvested from forests managed on sawtimber rotations, in the form of logs too small or otherwise unsuitable for use as sawtimber). Rotation lengths vary depending on tree species, desired product, site quality and region.

Roundwood products: Logs, bolts and other round timber generated from harvesting trees for industrial or consumer use. In this volume, which follows the conventions of the USDA Forest Service and other federal agencies, roundwood includes so-called logging residues, which are wood chips made from wood that would otherwise be left on-site.

Runability: Paper properties that affect the ability of the paper to run in office equipment and printing presses.

Sawtimber: Classification of timber inventory that is composed of sawlog-sized trees of commercial species. Sawlogs are logs meeting minimum standards of diameter, length and defect; they include logs at least 8 feet long that are sound and straight, and with a minimum diameter inside the bark of 6" for softwoods and 8" for hardwoods; other combinations of size and defect may be specified by regional standards.

SBS: Solid bleached sulfate boxboard.

Scoring: Creasing by mechanical means to facilitate folding and guard against cracking of the paper or board.

Secondary fiber: Recovered paper.

Secondary treatment: Wastewater treatment systems that use microorganisms to convert the dissolved organic waste in the effluent into a more harmless form. Although primarily designed to remove BOD, secondary treatment also reduces the loading of COD and AOX.

Seconds: Paper that is damaged or has imperfections.

Sedimentation: Deposition of eroded soil into streams or bodies of water. Depending on stream flow and other site conditions, deposited sediment can settle on the stream floor, burying gravels in the streambed and degrading spawning habitat for fish. Elevated sediment concentrations in water can also harm filter-feeding organisms and may interfere with the functioning of the gills of some organisms.

Seed-tree method: Even-aged harvesting/regeneration method in which all of the merchantable timber in a stand is removed in one cutting, except for a limited number of seed trees left singly or in small groups as a seed source to facilitate natural regeneration. These trees typically are harvested after the stand has successfully regenerated.

Selection method: Harvesting/regeneration method used in uneven-aged silviculture in which mature trees are removed, individually (single-tree selection) or in small groups (group selection), from a given tract of forestland over regular intervals of time.

Semi-chemical pulp: Pulp made by a combination of mechanical and chemical processes; typically used to make corrugating medium.

Shade-intolerant species: Tree species (or, more broadly, plant species) that are generally outcompeted in shaded conditions but grow vigorously in full sunlight. Many commercially valuable species, such as loblolly pine and Douglas fir, are shade-intolerant. Because of their preference for light, shade-intolerant species are usually managed using even-aged systems.

Shearing: Site preparation method that involves the cutting of brush, trees or other vegetation at ground level using tractors equipped with angles or V-shaped cutting blades.

Sheet: Term applied to a single sheet, a paper grade or a description of the paper; i.e., coated, uncoated, or offset.

Sheeting: Process of cutting a roll of paper or board into sheets.

Shelterwood method: Removal of the mature timber from a stand in a series of cuttings (usually two) that extend over a relatively short portion of the rotation, in order to encourage the establishment of essentially even-aged reproduction under the shelter of a partial canopy. In *irregular shelterwood*, the period between the first and second cutting is extended to allow the development of a two-aged stand.

Shrinkage: Decrease in dimensions of a paper sheet; weight loss between amount of pulp used and paper produced.

Silviculture: The art and science of establishing, tending, protecting and harvesting a stand of trees.

Single-tree selection: Method of harvesting in which individual merchantable trees are removed periodically. Natural regeneration is typically relied on to fill in the resulting gaps.

Site preparation: Silvicultural activity to remove unwanted vegetation and other material, and to cultivate or prepare the soil for regeneration.

Size press: Press section of the paper machine, near the end, where sizing agents are added.

Sizing: Process that enables paper to resist penetration by fluids. Sizing can also provide better surface properties and improve certain physical properties of a sheet. The papermaker generally applies either surface or internal sizing, which can be applied as sole treatments or in combination.

Skid trail: Temporary, non-structural pathway over forest soil used to drag felled trees or logs to the landing.

Skidding: Short-distance moving of logs or felled trees from the stump to a point of loading.

Slash: See logging debris.

Slice: Device that controls the flow of pulp from the headbox of a fourdrinier paper machine.

Slurry: Watery suspension of fibers or pigment used in papermaking or coating, respectively.

Smoothness: May be measured by the degree of resistance that the paper provides to air moving across its surface. Smoothness influences print quality, ink holdout and transport of paper through machine. The degree of smoothness of an uncoated grade of paper is determined by fiber species, fiber length and finishing processes such as surface sizing and calendering.

Snags: Dead but still standing trees. Snags are important habitat for many species of wildlife: an abundance of invertebrates; birds that construct or nest in cavities and/or feed on the invertebrates; and small mammals that live in the cavities.

Sodium hypochlorite: Bleaching chemical produced by mixing sodium hydroxide and elemental chlorine. Mills are eliminating this chemical from bleaching processes because it produces chloroform.

Softwood: Coniferous, usually evergreen, tree that has needles or scale-like leaves; e.g., pine, Douglas fir and spruce.

Solid board: Paperboard made of only one type of furnish.

Sorted office paper: Paper typically found in offices; may contain a small percentage of groundwood papers such as computer printout and fax paper, but is free of unbleached fiber such as corrugated boxes.

Solid chipboard: Board made entirely from wastepaper with no liner or coating: Produced on a cylinder machine.

Species diversity: Measure of the abundance and relative frequency of species in a specified area. Species diversity is often used with respect to animal or plant populations in a single

stand, but can also be thought of on regional and global scales. For the purposes of biodiversity conservation, spatial scales of species diversity are hierarchical: global diversity is a higher conservation priority than regional diversity, and both are more important than local or stand-level diversity.

Stand: Contiguous group of trees sufficiently uniform in species composition, arrangement of age classes and condition to be a homogenous and distinguishable unit; also the area defined by the extent of those trees.

Starch: Sizing agent usually made from corn and potatoes; improves rigidity and finish by causing fibers to lie flat.

Stem-exclusion stage: The second stage of stand development in a forest, in which the forest canopy closes and the arrival (or *recruitment)* of new seedlings halts. Because a closed canopy limits the amount of light reaching the forest floor, understory growth is limited, stand vegetation is simpler and species diversity tends to be lower than in other stages.

Stickies: Particles of plastic, adhesives or naturally tacky materials (e.g., pitch from pine trees) that are embedded in the paper sheet or attached to the forming machine; caused by non-soluble residual particles of hot-melt glues, adhesive labels and other contaminants present in secondary fiber.

Stiffness: Ability of paper to resist deformation under stress and to resist bending stress. It affects how well the paper performs in transport through press and office equipment and during converting. The properties of stiffness are determined by the basis weight and caliper of the paper, the type and quantity of fiber and filler used in the paper, and the degree of fiber bonding.

Stock: (1) Paper or board that is in inventory. (2) Paper or board used in the printing or converting process. (3) Fibrous mixture that is made into paper; also called furnish. (4) Wastepaper.

Stone groundwood (SGW) pulping: Process of pressing logs against a grindstone while a stream of water wets the stone and removes the pulp. This process has the highest yield (93 - 96%) of all pulping processes, but it also produces the weakest pulp.

Streamside management zone (SMZ): May also be called buffer strips or *riparian management areas.* Zone of forest along a forest stream where management practices that might affect water quality, fish or other aquatic resources are modified. Properly designed SMZs effectively filter and absorb sediments, maintain shade, protect aquatic and terrestrial riparian habitats, protect channels and streambanks and promote floodplain stability. State Best Management Practices generally recommend SMZs, although restrictions and key parameters (e.g., SMZ width) vary.

Strength: Generally three types of strength are measured: folding, tensile and tear. Strength is important so paper can run through machines without tearing and can withstand folding without cracking. A paper's strength is determined by interfiber bonding during sheet formation, fiber strength, the type of fibers and filler in the sheet, basis weight of the sheet and the degree of refining.

Stumpage: Trees "on the stump." Landowners sell these trees to loggers for which they are paid a given price (*stumpage price*).

Succession: With respect to forest development, succession refers to the changes over time as a forest proceeds from one developmental stage to the next: thus early-successional stands describe stands in the years just after regeneration, while late-successional stands refer to stands in mature or old-growth forests.

Sulfate pulp: See kraft pulp.

Sulfite pulping: Pulp produced with sulfur dioxide and calcium, magnesium, ammonium or sodium bases. The pulp can be produced at different pH levels. The higher the pH, the stronger the pulp produced. At pH = 14, the strength of sulfite pulp equals that of kraft pulp.

Sulfur dioxide: (SO_2): Chemical compound produced when boilers burn fuel that contains sulfur. Of the fuels used in the paper industry, oil and coal generally contain the highest quantities of sulfur.

Supercalendering: Process that uses alternate metal and resilient rolls to produce a high finish paper separately from the papermaking machine. Supercalendered (SC) papers have been smoothed through an extra calendering phase during papermaking; have clay and other pigments that enhance appearance by adding brightness, smoothness, opacity, strength and bulk.

Surface strength: Cohesiveness of fibers on the surface of a paper.

Surface-sized: Term applied to paper to which a sizing agent has been applied when the paper web is partially dry. The purpose of surface sizing is to increase resistance to ink penetration.

Suspended solids: See total suspended solids.

Tack: In printing inks, the property of cohesion between particles. A tacky ink has high separation forces and can cause surface picking.

TAPPI: Technical Association of the Pulp and Paper Industry.

Tear strength: Indicator of the fiber length and the uniformity in refining and formation of a paper sheet. Tear strength is especially important to printers and lithographers. It is determined by a test that measures the average force in grams required to tear a single sheet of paper once the tear has been started.

Tensile strength: Defined as the maximum force required to break a paper strip of a given width under prescribed laboratory conditions; measured as the force (pounds per inch) per unit width of a sample that is tested to the point of rupture.

Text paper: General term applied to various grades of printing papers that are made specifically for books.

Thermomechanical pulp (TMP): Pulp produced from wood chips that have been exposed under pressure to superheated steam. The heat softens the lignin, which allows fiber separation with less damage than in purely mechanical pulping. TMP processes use a refiner that consists of one or two rotating serrated disks to separate the fiber in wood chips. TMP processes reduce the energy requirement of the refining process and increase the strength of the pulp. Typical pulp yields range from 90% to 95%.

Tip fees: Solid waste disposal charges; a refuse collection truck empties or "tips" its load at a landfill, transfer station or incinerator.

Tissue paper: Paper category characterized by extreme lightness and transparency; basis weight is less than 18 lbs. Tissue paper is used to make napkins, bathroom tissue, paper towels, etc.

Titanium dioxide: Chemical compound used as loading or coating material to increase the whiteness and brightness of a paper sheet and enhance its opacity.

Topliner: Outermost layer of multi-ply paperboard.

Total energy consumption: Energy, including electricity and all forms of fuels, consumed to produce a ton of pulp or paper.

Totally chlorine-free (TCF): Bleaching process that uses no chlorine-based chemicals.

Total reduced sulfur compounds (TRS): Mix of organic compounds that cause the odor associated with kraft pulp mills. These compounds include hydrogen sulfide, dimethyl sulfide, dimethyl disulfide and methyl mercaptan.

Total suspended solids (TSS): Amount of solids in the effluent. They can eventually settle on the bottom of a mill's receiving water and affect the habitat of bottom-living organisms. Well-operated treatment systems remove most of these solids. Concern remains, however, because heavy metals, dioxins and other unchlorinated compounds can be adsorbed onto the remaining suspended solids.

Toxic equivalence (TEQ): The EPA uses toxic equivalence factors (TEFs) to estimate the relative toxicity of different members of the dioxin and furan families, because they produce similar toxic effects, but at different doses. E.g., TCDD is the most toxic member of the dioxin and furan family and is assigned a toxic equivalence factor of 1.0, while the less toxic TCDF is assigned a toxic equivalence factor of 0.10. Using these factors, the sum of the toxicity of one gram of TCDD and one gram of TCDF would be equal to 1.1 grams TEQ of TCDD.

Twin-wire machine: Paper machine in which pulp slurry is injected between two forming wires, and water is drained from both sides of the paper web.

Two-sidedness: Visual differences between the top (or felt) side of a paper sheet and the bottom (or wire) side.

Unbleached: Paper or paperboard made from natural colored pulp that has not been brightened.

Uncoated freesheet: Bleached uncoated printing and writing papers containing not more than 10% groundwood or other

mechanical pulp.

Uncoated: Paper or board that has not been coated. Uncoated paper grades are made in a variety of finishes.

Uncoated groundwood papers: Papers containing more than 10% mechanical pulp (stone groundwood, refiner or thermo-mechanical) in their furnish, excluding newsprint.

Understory: Level of vegetation between the ground and the forest canopy, or overstory.

Uneven-aged management: Class of silvicultural systems that maintain several age classes of trees simultaneously in a forest. In a managed uneven-aged forest, the objective of management is to create and maintain a certain distribution of trees: many more trees are in small size (age) classes than in large ones. The selection method, either single-tree or group selection, is the harvesting/regeneration method used in uneven-aged management.

Volatile organic compounds (VOCs): Broad class of organic gases, such as vapors from solvents and gasoline that react with nitrogen oxides in the atmosphere to form low-level atmospheric ozone.

Washing deinking: Process of removing ink by dewatering pulp.

Web break: Break in a roll of paper while it is on the machine during manufacturing or on the printing press during production.

Web: Continuous sheet of paper produced and rolled up at full width on the paper machine.

Wet end: Beginning of the paper machine where the headbox, forming wire and press section are located.

Wet-strength paper: Paper that retains 15% or more of its dry tensile strength when wet.

Wetlands: Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include *swamps*, *marshes*, *bogs* and similar areas. (This definition is taken verbatim from regulations of the Environmental Protection Agency, published in the *Code of Federal Regulations*, Volume 40, Part 230.3(t). The U.S. Army Corps of Engineers, which shares authority over wetlands with EPA, uses the identical definition. *Code of Federal Regulations*, Volume 33, Part 323.2 (c).)

Whole-tree harvesting: Practice of removing entire trees at harvest, including tops, limbs, branches, twigs and leaves. In many cases, these trees are chipped whole on site to produce *whole-tree chips.*

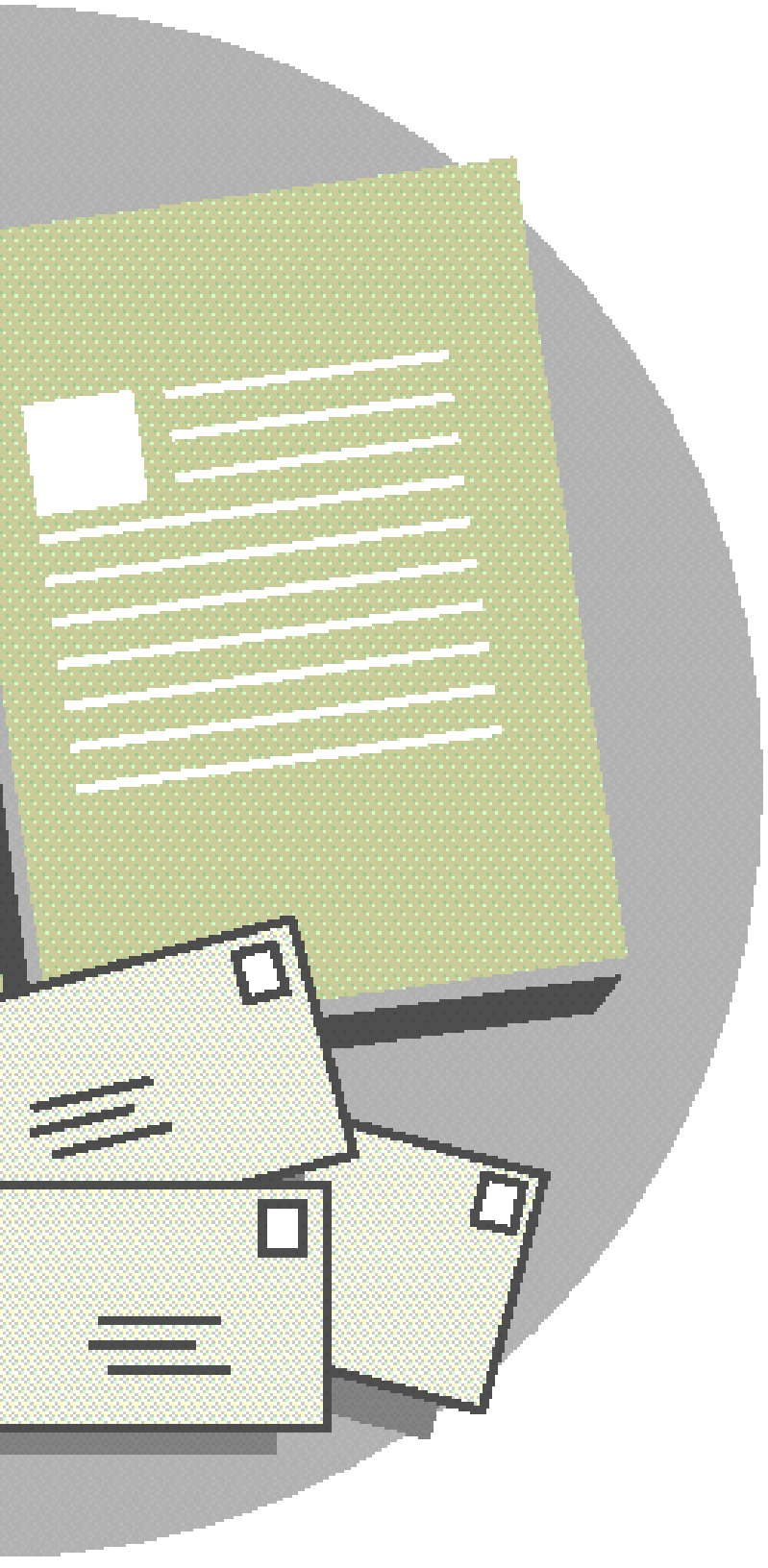
Window envelopes: Envelopes with openings that show the mailing address; openings are either open or covered with plastic or glassine.

Windrowing: Silvicultural activity, associated with intensive site preparation, that removes logging debris and unmerchantable woody vegetation into rows or piles to decompose or be burned.

Wire: The bottom side of a sheet of paper is the side that has had contact with the wire of the paper machine during manufacture. The wire is a synthetic (often polyester), copper or bronze screen that transports the water and fiber suspension from the wet end to the dry end of a paper machine.

Xerography: Copying process that uses a selenium surface and electrostatic forces to form an image, i.e. “photocopying”.

Yarding: Method of transport from harvest area to storage landing.



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